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WARNING

Because of possible shock or fire hazards, connection of this instrument should be performed in compliance with the National Electric Code (ANSI C1) or any other requirements, or both, which may be applicable to the user. Installation, operation, and maintenance should only be performed by qualified personnel.

TM-103700

VOLUME 1 -- OPERATOR'S MANUAL

SYSTEM 22

SEQUENCE OF EVENTS RECORDER

Revised March 1, 1984
Revised February 15, 1987

See opposite side relative to proprietary rights.

NOTE: Refer to Volume 2 of TM-103700 for maintenance and servicing instructions.

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Dranetz Technologies, Inc.
1000 New Durham Road
Edison, New Jersey 08818
(201) 287-3680

908-287-3680

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This volume contains information of interest to the SER System 22 operator. Section I (General Information) discusses the purpose and application of the system and the possible system configurations, identifies the mainframe equipment and the associated options, and summarizes the technical characteristics and specifications of the equipment. Section II (Installation and Operation) presents unpacking and installation data, setup instructions, wiring information, and an operational description. In Section III (Special Features), the special features resident within the SER program are described. Section IV (Hardware Specifications and Technical Information) provides reference information for the most popular options available for use with the SER Mainframe. A complete list of SER system commands appears in Section V.

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IMPORTANT! CALIBRATION INTERVAL

The recommended calibration interval for this unit is once every **12 MONTHS.**

We recommend that you return the unit to the factory for calibration. If you decide to do so, first contact Dranetz Service Corp. to obtain an authorization number.

Telephone Number: (201) 755-7081
Telex Number: 499-7808
TWX Number: (710) 997-9553
FAX Number: (201) 755-0292
Cable: DRANETZ

Then fill out the Repair/Service Order form enclosed in this manual and ship it along with the unit to Dranetz Service Corp. (If this form is missing, ask Dranetz Service Corp. for a replacement.)

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SECTION I

GENERAL INFORMATION

1.1 INTRODUCTION

This volume of the manual provides operating instructions for the SER System 22 Sequence of Events Recorder (hereinafter referred to as the SER or the system), manufactured by Dranetz Technologies, Incorporated, Edison, New Jersey. (See figure 1-1.) Volume 2 contains the maintenance instructions for the SER. This section of the manual describes the purpose, application and technical characteristics of the SER.

The SER may be supplied in many configurations, depending on the size and requirements of the site for which it is intended. Unless otherwise specified, these operating instructions apply to all SER models.

1.2 PURPOSE

The SER System 22 monitors the state of up to 1024 inputs. It senses, identifies, and records, in a convenient alphanumeric printout, rapid state changes of such inputs as electromechanical or solid-state relays with a time resolution of 1 millisecond. Utilizing an advanced microprocessor-based design, the SER provides highly accurate and reliable time sequence information, even from extremely noisy sources.

Event information will be printed almost immediately after inputs have changed state. Thus, the printer will normally not be operating except for a 24-hour summary listing of inputs in the alarm state, when the system responds to a user-initiated command, or when the system's self-diagnostics detect an abnormal condition.

Information may be sent remotely through the system's RS232C interface. All user commands may be initiated through this interface. These features permit long term unattended operation.

Either of two available SER Event Processor models contains all the required software and hardware for all system configurations. The Model 2210-MPT Event Processor contains an integrated front panel printer-keyboard-display combination and can be used as a self-contained SER system. Input channel capability may be field expanded by adding input panels. If desired, a remote teletype may be connected to the 2210-MPT, enabling keyboard/printer operation locally and/or remotely.

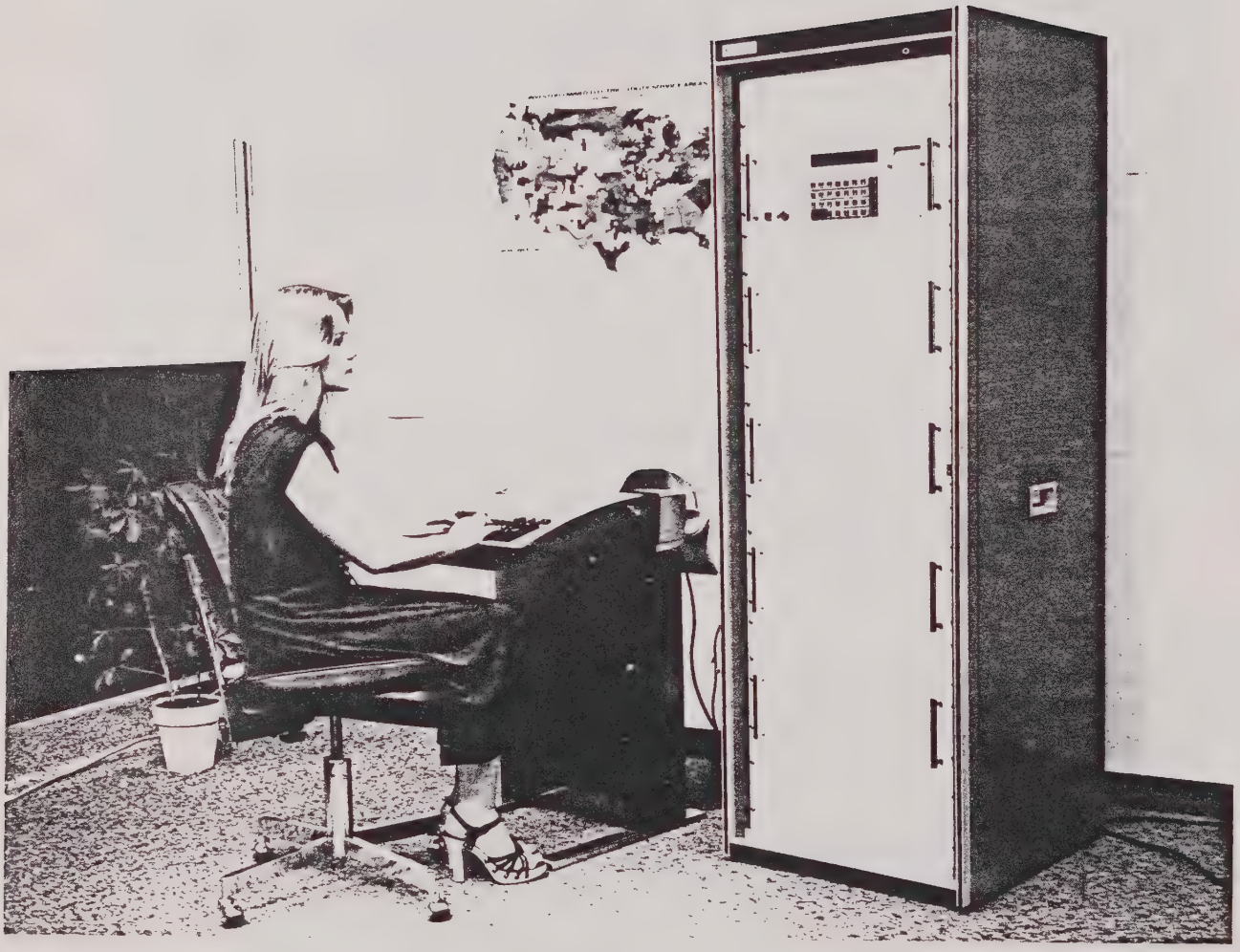

Figure 1-1. System 22 with Event Processor/Terminal, Input Conditioning Units and Teletype Remote Terminal

The Model 2210-MP Event Processor is identical to the 2210-MPT except that it does not include the integrated front panel printer-keyboard-display combination. An external local or remote output device, such as the Dranetz optional teletype, must therefore be used with this model.

A unique self-contained power supply and automatic switchover circuit in both Event Processor models ensure continuous SER operation from either an AC source or Station Battery.

1.3 APPLICATIONS

Intended primarily for use with power utility substations, generating stations or other installations equipped with extensive mechanical or solid-state relay switching facilities, the SER provides a printed record that is invaluable for the following applications:

Troubleshooting: By analyzing SER printouts during a system's ongoing operation, it can be determined if equipment switched at the proper time and in proper sequence. Malfunctioning equipment may then be pinpointed.

Diagnostics: After a complex protective relay system responds to a fault condition, a System 22 user can determine which protective equipment switched first and then analyze the subsequent sequence of events to understand the initial fault condition and its effect on the rest of the system.

Documentation: This application covers a broad area in which it is important to know the frequency or total magnitude of equipment operations for maintenance scheduling or equipment utilization reports.

Testing: A protective relay system may be trip tested off line to determine if the system timed out properly and whether each phase operated in the proper order. The portable 32-channel SER is especially useful for this application.

NOTE: Refer to the Dranetz System 22 series of application notes for specific applications.

1.4 OTHER FEATURES

1.4.1 Alphanumeric Input Descriptors

To facilitate identification of the input channels being monitored, the SER permits the user to store an alphanumeric identifying tag or descriptor for each input on electrically alterable non-volatile read only memory. This identifier automatically accompanies subsequent printouts that refer to the particular channel.

Descriptors are programmed from the system keyboard (Model 2210-MPT) or remote terminal keyboard (Model 2210-MPT or 2210-MP) and can be reprogrammed at any time.

1.4.2 High Input Noise Immunity

Shielding, optical couplers, analog filtering, and time-synchronized digital filtering networks ensure reliable SER operation from extremely noisy station batteries and reject the effects of relay bouncing.

1.4.3 Diagnostic Capabilities

Self-Diagnostics occur on a continuous basis to ensure proper operation. In addition, user-initiated diagnostic routines are programmed into the system to simplify system troubleshooting.

1.5 SYSTEM CONFIGURATION

The heart of SER System 22 is the Event Processor; either the 2210-MPT or 2210-MP. Each of these Event Processors is 19" wide X 7" high X 22" deep and contains all the required system software and hardware, regardless of the size of the system. (See figures 1-4 and 1-5.) The actual size of the system (1024 inputs maximum) is determined by the number of input boards included in the system.

There are several models of input boards which can be used in the SER. However, all the boards are classified into two distinct categories. The first is eight channel boards. These boards usually contain eight channels. The four channel threshold boards are considered as eight channel boards with four unused channels. The second category is the 32 channel input board. When a system is configured using eight channel boards, it can use up to sixteen input conditioning units. [8 channels per board] [8 boards per ICU] [16 ICU's per system] = 1024 channels.

Both types of boards (8-channel and 32-channel) may be used within the same system. Whenever a 32-channel board is used in a system, each input board position in the ICU represents 32 channels. Therefore any 8-channel board will have 24 unused channels within the system. Similarly, a 4-channel threshold board will have 28 unused channels.

NOTE: Unused channels are assigned descriptor memory and must be accounted for when determining the amount of total descriptor memory.

Input boards are housed in mainframes designated 2211-MC Input Conditioning Units (ICU's). Each ICU is 19" wide X 7" high X 22" deep and may contain up to 8 input boards. (See figure 1-6.) Enclosures are available in different heights and widths to accommodate the selected mainframes and optional equipment.

Each Event Processor contains three control boards to provide control logic and memory functions. In addition, it is equipped with RS232C interface. Space for the power supply is also provided within the Event Processor Mainframe. Battery transfer to station battery is a standard feature of the Event Processor. For larger systems, a heavy duty power supply is available. For space efficiency, four input boards may also be included in the Event Processor, at the option of the user. This permits the Event Processor mainframe to be a complete self-contained portable Sequence of Events Recorder. When input boards are included in the Event Recorder, the optional Model 2210-O-140 Input Decode Board must be included. This Decode Board is included in the Model 2211-MC-ICU as a standard item.

1.5.1 Event Processor Mainframe Options

Table 1-1 identifies the Event Processor mainframe equipment and associated options by Model number.

Table 1-1. Event Processor Mainframe and Options

Model No./Description	Comments
Mainframe	
2210-MP, Event Processor Mainframe	
2210-MPT, Event Processor/Terminal Mainframe	Includes integrated front panel printer-keyboard display.
2210B-MP, Event Processor Mainframe	48V DC power supply input
2210B-MPT, Event Processor/Terminal Mainframe	48V DC power supply input

Table 1-1. Event Processor Mainframe and Options (Cont'd.)

Model No./Description	Comments
Input Descriptor Memory Options	
2210-O-130 Descriptor Memory 2048	Descriptor Memory Option consisting of 2048 characters.
Input Board Options	
2210-O-204, 32 Channel Inputs	32 channel input board with single common
2211-O-208D, 115V AC Input Board, 8 Ch	8 Channel AC input board. (120 VAC)
2211-0-211M, 20 mA Threshold Board, 4 Ch	4 channel threshold board. 4-20 mA
2211-O-211N, 5A Threshold Board, 4 Ch	4 channel threshold board. 1-5 Amps
2211-O-212F, 5V Threshold Board, 4 Ch	4 channel threshold board. 1-5 Volts
2211-O-212G, 10V Threshold Board, 4 Ch	4 channel threshold board. 2-10 Volts
2211-O-212H, 20V Threshold Board, 4 Ch	4 channel threshold board. 4-20 Volts
2211-O-212J, 130V Threshold Board, 4 Ch	4 channel threshold board. 20-130 Volts
2211-O-203A, 24V Input Board, 8 ch - SWC 2211-O-203B, 48V Input Board, 8 ch - SWC 2211-O-203C, 90V Input Board, 8 ch - SWC 2211-O-203D, 125V Input Board, 8 ch - SWC	8 channel Input with redundant optical couplers and EMI filtering on same PC board.
Input Decode Board Option	
2210-O-140, Input Decode Board	Required when Input Boards (above) are included in the 2210-MP or 2210-MPT.

Table 1-1. Event Processor Mainframe and Options (Cont'd.)

Model No./Description	Comments
Input Termination Connector Options	
2211-O-233, Screw Connector	8 channel connectors for termination of field wiring. Connector mates to front of Input Board. Screw connector accepts 12 to 24 gauge wire.
2211-O-234, Screw Connector, 32 Channel	32-channel screw type connector. For use with 32-channel board.
System Power Supplies	
NOTE: One of these power supplies must be ordered with each Event Processor	
2210-O-300, Standard Power Supply	Used for systems up to 256 channels.
2210-O-310, Heavy Duty Power Supply	Used for fully expanded systems.
2210-O-310B, 48V Heavy Duty Power Supply	Same as -310 except for 48 VDC input.
2210-O-320, System Power Supply	Used for expanded system and extended DC input range.
2210-O-320B, 48 VDC System Power Supply	Same as -320 except for 48 VDC input.

1.5.2 Input Conditioning Unit Mainframe Options

Table 1-2 identifies the Input Conditioner mainframe equipment and associated options by Model number.

Table 1-2. Input Conditioning Unit Mainframe and Options

Model No./Description	Comments
Mainframe	
2211-MC, Input Conditioning Unit Mainframe	Holds up to eight Input Boards. Includes Decode Board and panel-to-panel cabling.
Input Board Options	
(Same as those listed in Table 1-1 for use with 2210-MP and 2210-MPT.	
Input Termination Connector Options	
(Same as those listed in Table 1-1.)	

1.5.3 System Options

The system options available include remote terminal equipment, enclosures and others. Table 1-3 identifies the system options by Model number.

Table 1-3. System Options

Model No./Description	Comments
Remote Terminal Options	
2212-O-1041, Remote Terminal	Teletype Model 43 Terminal operates from 117 VAC. (For DC operation, use Model No. 2212-O-1046 Adapter.)
2212-O-1048, Remote Terminal Stand	
2212-O-1046, Battery Adapter, Terminal	Station battery adapter for continuous remote terminal operation from 117 VAC or 125 VDC. Includes transfer circuits and DC voltage booster. Adapter is mounted in 3-1/2" panel for rack mount.

Table 1-3. System Options (Cont'd.)

Model No./Description	Comments
Enclosure Options	
2212-O-1001, 7" Enclosure	Holds one 2210-MP, 2210-MPT or 2211-MC.
2212-O-1002, 17" Enclosure	Holds one 2210-MP or 2210-MPT and one 2211-MC.
2212-O-1006, 90" Enclosure	90" x 24" x 24" steel enclosure, removable side and top. Rear door ANSI 61 Grey.
Miscellaneous Options	
2212-O-1010, Chassis Slide Set	Can be used for any mainframe (2210-MP, 2210-MPT, or 2211-MC). Not compatible with 2210-O-1001 or 2210-O-1002.
2212-O-1060, Descriptor Loader, Portable	Cassette deck used for storing and reloading descriptor memory from EEROMs.
2212-O-1061, Descriptor Loader, Rack Mount	
2211-O-401, Alarm Contact Relay Board	Relay outputs as defined in Table 1-6 for external monitoring of SER.
2212-O-1091, Maintenance Kit	Includes a 6" and 9" extender board and 15" extender cable for printer/display interface cable to CPU.

1.6 TECHNICAL CHARACTERISTICS AND SPECIFICATIONS

1.6.1 Event Memory Capacity

The SER is capable of maintaining 1052 individual events. Depending on the rate at which events occur, data may be compressed in memory, allowing additional event memory capacity. When the accumulation functions are enabled, event memory capacity is reduced to a minimum of 625 individual events. When "Out of Time" or "Out of Sequence" functions are being used, event memory capacity is 398 events.

1.6.2 Memory Overflow

Should the events being monitored exceed the event memory capacity, the SER will cease to monitor any further changes of state. Event printing will continue until all events are printed out. Once the memory has been cleared, normal monitoring will resume.

Whenever the stack contains no additional data, a line feed is generated and the stack pointers are reset to their initial conditions.

1.6.3 Input Descriptor Memory

Input descriptors will be stored on electrically eraseable, non-volatile memory. The descriptor size (characters per descriptor) is available in increments of 8 characters up to a maximum of 120 characters. The maximum number of total system characters is 65,280. On all units, descriptors may be programmed or reprogrammed in the field, using the system keyboard or remote terminal keyboard.

An optional Descriptor Loader Cassette Deck [2212-O-1060, 1061] allows for quick and easy storage of descriptors onto cassette tape from EEROM memory, automatically under system control, or for reprogramming the descriptors from information stored on the tape. This allows the user to program the descriptors in a remote office, then take the Descriptor Loader out into the field and program the descriptors quickly on site. Either a portable or rack mount version is available.

Char/Leg	0	8	16	24	32	40	48	56	64	72	80	88	96	104	112	120
Sw Pos	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F

1.6.4 Point Identification Nomenclature

All inputs are designated by a 4-digit number (0001-1024). This identification number precedes all printouts which reflect data concerning a particular input.

1.6.5 Status (State) Nomenclature

The words ALARM and NORM are used to describe the status of any one input. The specification for these two descriptions is assigned by the user. Status words may also be assigned by the user. Refer to Section III.

1.6.6 Event Resolution Time: 1 millisecond / 512 channels - 8-ch boards
1 millisecond / 1024 channels - 32-ch boards

NOTE: All events which occur within any 1-millisecond period are considered as occurring simultaneously.

1.6.7 Time Resolution: 1 millisecond

1.6.8 Real Time Clock

The Real Time Clock is internally generated from a crystal oscillator. The time is set through either the front panel keyboard or through the remote keyboard.

Crystal Stability = $\pm$10 PMM (10^{o}C-45^{o}C)
Typically= $\pm$5 PMM (20^{o}C-30^{o}C)

The system real time may also be supplied by an external source. Binary Coded Decimal (BCD) format is used. Input connections are provided for milliseconds, seconds, minutes, and hours. There is a minimum performance test for external time. If there is an error on any of the millisecond or seconds bits, the SER will default to the internal time. When using the internal time as system time, the SER checks for proper operation of external time. If the external time is operating properly for a half hour prior to the hour digit changing, system time transfers to external time. If an error is detected on any of the minutes and hours bits, an error message is generated. The system does not transfer to internal time. At midnight, the internal time clock is set to the external time clock only if there have been no errors that day.

1.6.9 Zero Time Sync

A positive edge pulse will set the system time to XX:00:00.000 where the value of hours (XX) is set to the closest hour. That is, it is set to the next hour if minutes are greater than 30.* An error message will be generated if the difference between the old and the new time exceeds one second. A 5-minute window may also be used to prevent erroneous time settings.

The function will not be executed when events are in memory (in order not to disturb relative time differences between events in memory and any events which may occur) or if the SER is operating from an externally supplied BCD time. Input signal is 15 to 40 VDC maximum, 4 mA maximum.

1.6.10 Key Switch Operation/Power

OFF - AC and DC power to the SER is disconnected (both sides of line).

OPER - Power is applied to SER power supply automatic transfer circuit. Keyboards (entry modes) are inhibited - key is removable.

SET - Same as OPER except keyboards (entry modes) are enabled. Key is not removable.

*Actual transition point is 30 minutes, 2 seconds.

1.6.11 Remote Communications

The Event Processor unit is equipped with a serial communication port. Connections are made via a 25-pin female connector at the rear of the unit. Pin assignment are given in Table 1-5.

The baud rate is switch selectable (internally located on the CPU board). (See Table 1-4.) Most popular rates are available. Data output to the port is user controllable using two system commands: RMT ON and RMT OFF.

Table 1-4. Baud Rate Selection

Switch Pos.	0	1	2	3	4	5	6	7
Baud Rate	50	75	110	134	150	300	600	1200
Switch Pos.	8	9	A	B	C	D	E	F
Baud Rate	1800	2000	2400	3600	4800	7200	9600	19200

Table 1-5. Remote Connector Pin Assignment

Pin Number RS232	CPU	Circuit	Description	To SER	From SER
1	1	AA	PROTECTIVE GROUND	-	-
7	13	AB	SIGNAL GROUND	-	-
2	3	BA	TRANSMIT DATA	X	
3	5	BB	RECEIVE DATA		X
4	7	CA	REQUEST TO SEND	X	
5	9	CB	CLEAR TO SEND		X
6	11	CC	DATA SET READY		X
20	14	CD	DATA TERMINAL READY	X	
12 *	23	5V	5 VOLT POWER SUPPLY		
13 *	25	-V	NEGATIVE 12-15 VOLTS		
25 *	24	+V	POSITIVE 12-15 VOLTS		

* CAUTION: These signals may interfere with the terminal. Check manual for terminal compatibility.

NOTE

It is suggested that the cable arrangement of figure 1-2 be used. Connections made in this manner will prevent the loss of data from the SER to the terminal when: 1) Paper supply is low, 2) Cable is accidentally removed or disconnected, or 3) Data terminal is not ready (local mode).

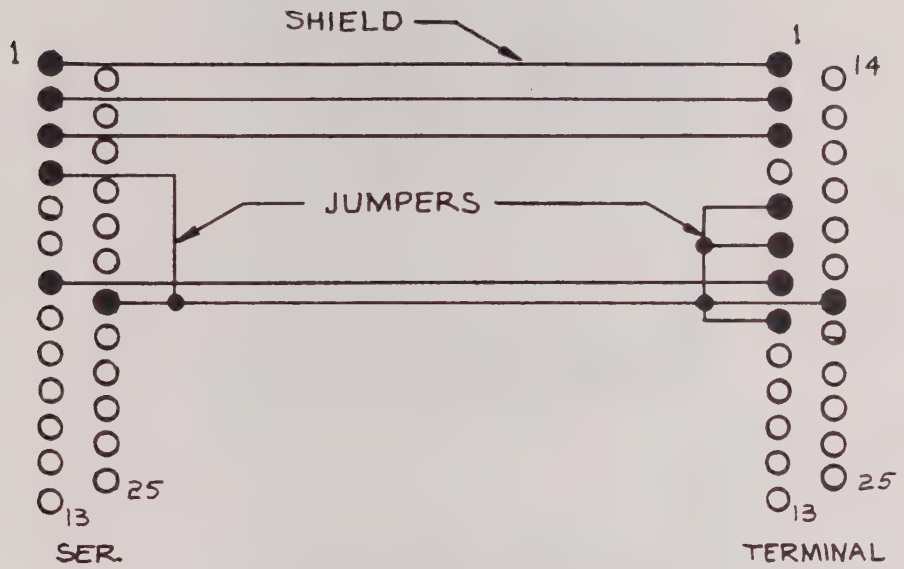

Figure 1-2 Basic Recommended RS232C Interconnections

1.6.12 Environmental:

Operating Temperature:	0°C to 55°C (32°F to 131°F)
Storage Temperature:	-20°C to 85°C (-4°F to 185°F)
Humidity:	Up to 80% (non-condensing)

1.6.13 Printer Speeds:

Front Panel Thermal Printer:	1 line/2 seconds typical
Remote Port (RS232C):	30 characters/second typical (300 Baud)

A typical change of state printout consisting of 1) Time, 2) Alarm-Normal indication, 3) Input point number and 4) 16 character descriptor would result in the following printing time:

Front panel printer:	6 seconds
Remote terminal:	2 seconds

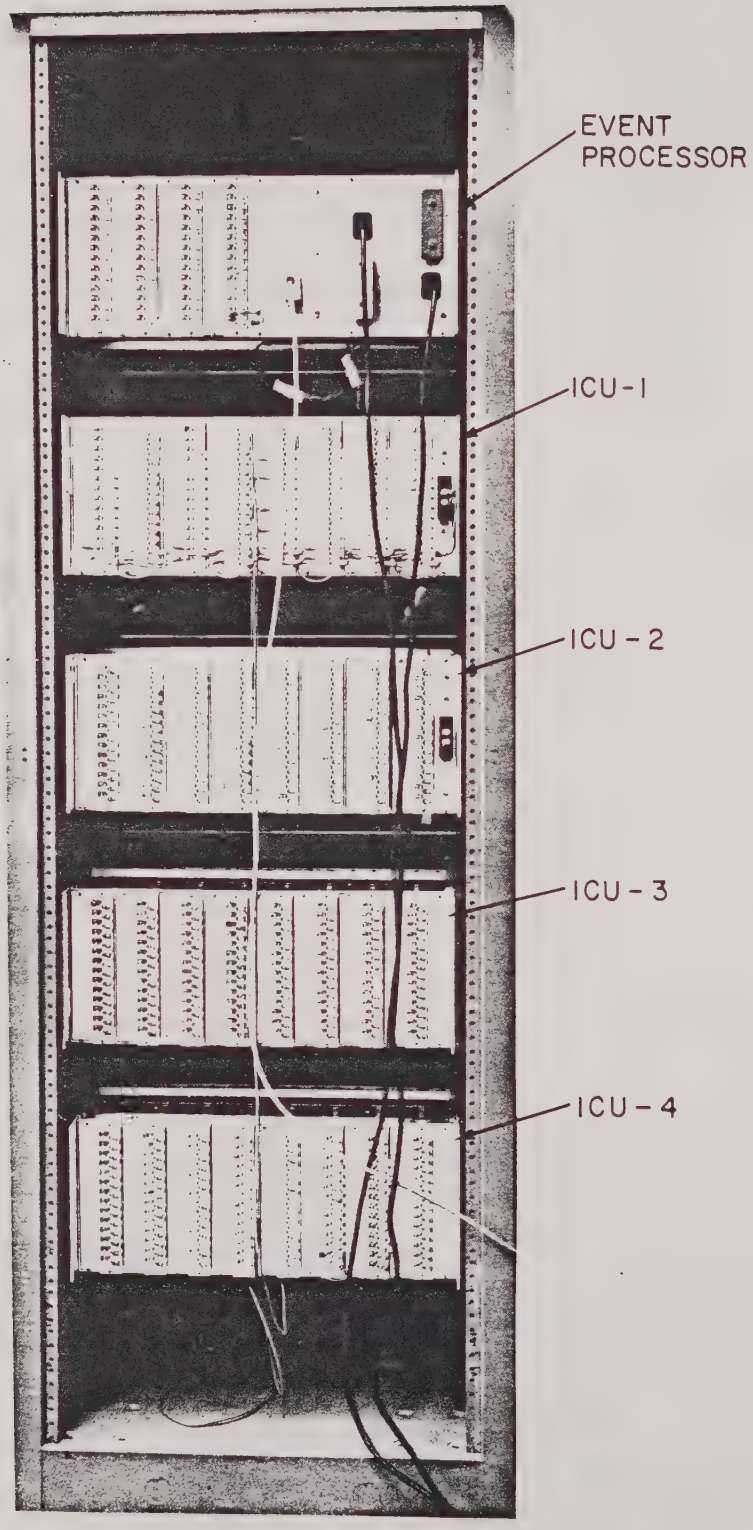

Figure 1-3. System Rack Enclosure, Rear View

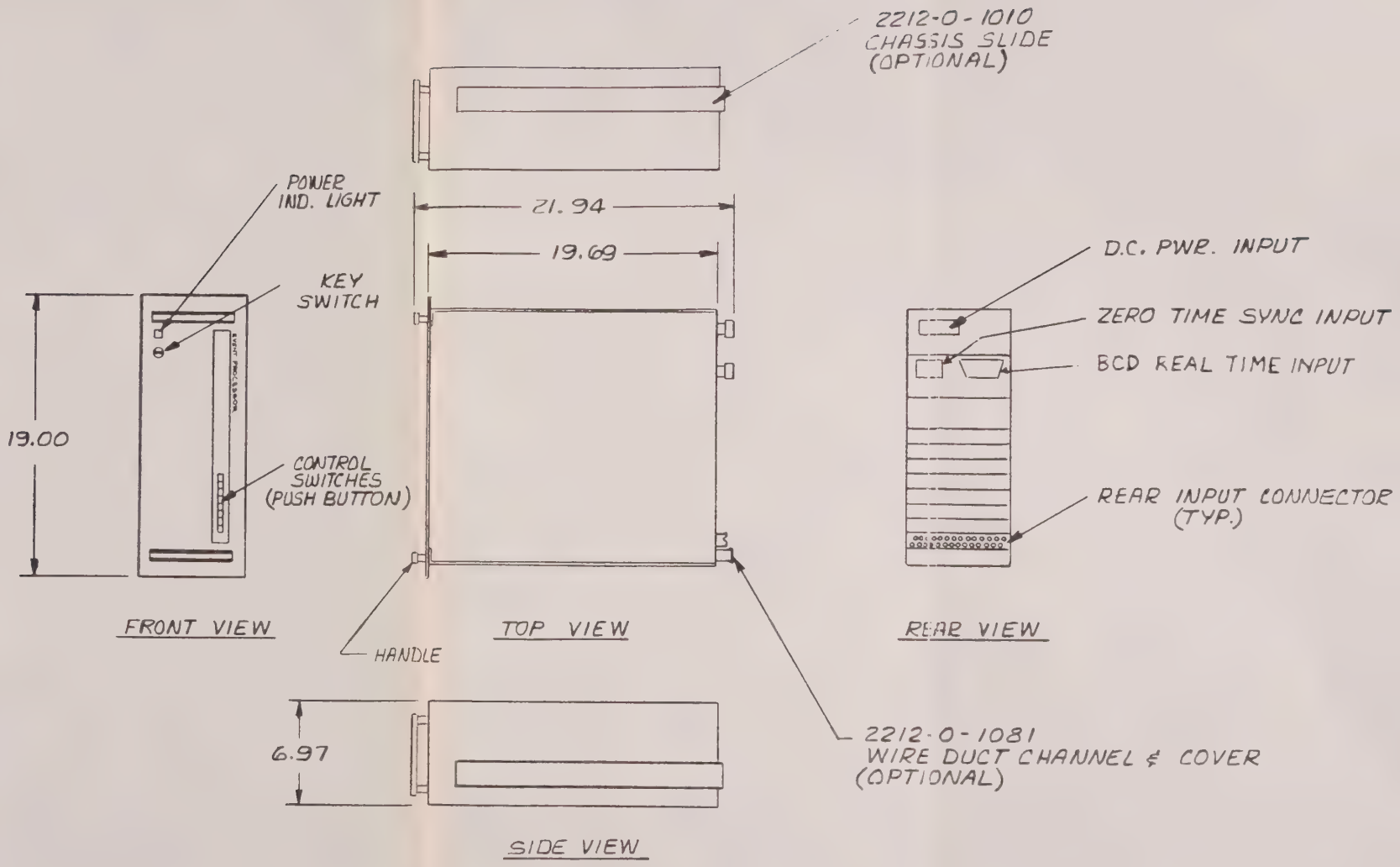

Figure 1-4. Event Processor Chassis 2210-MP

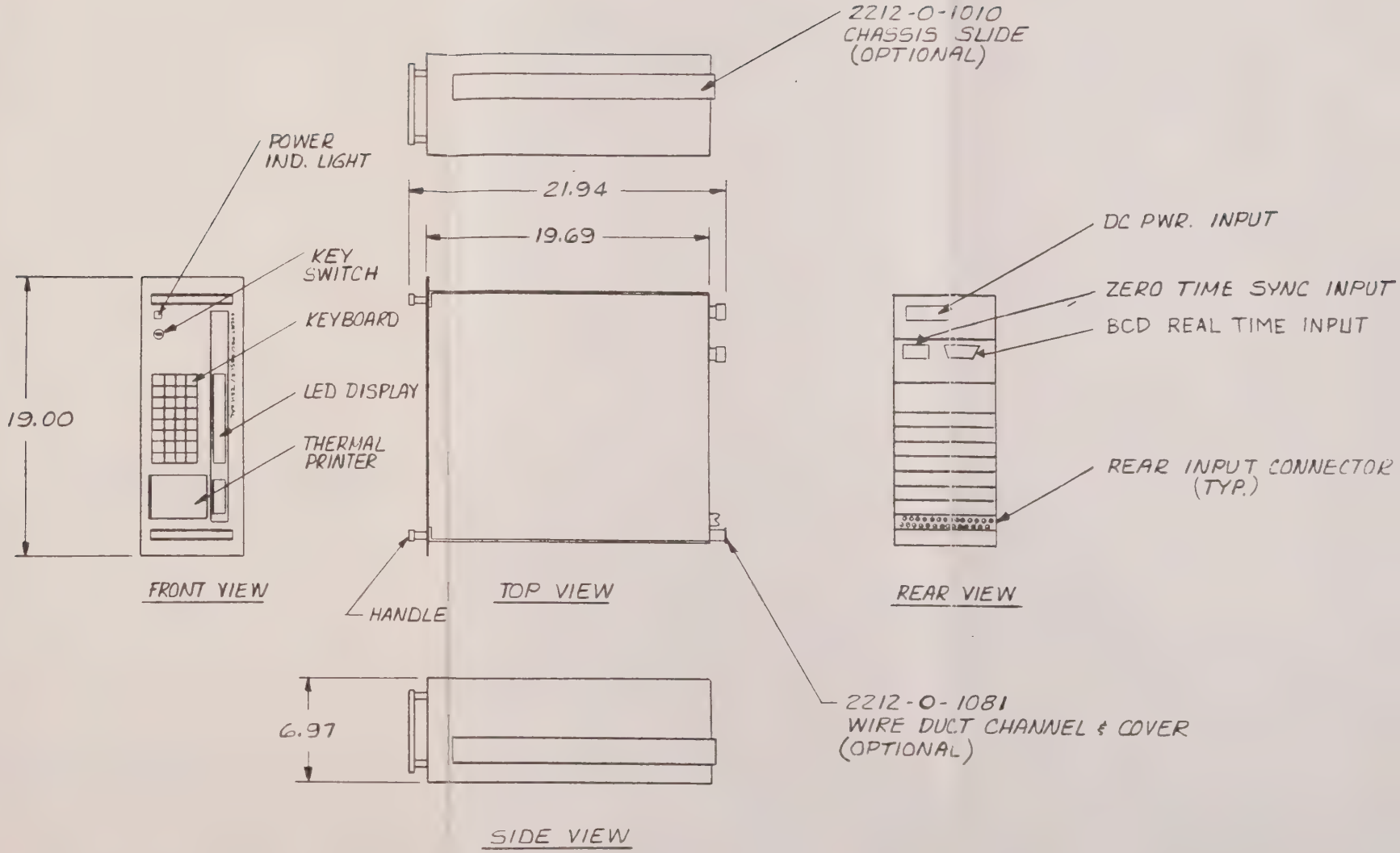

Figure 1-5. Event Processor Terminal Chassis 2210-MPT.

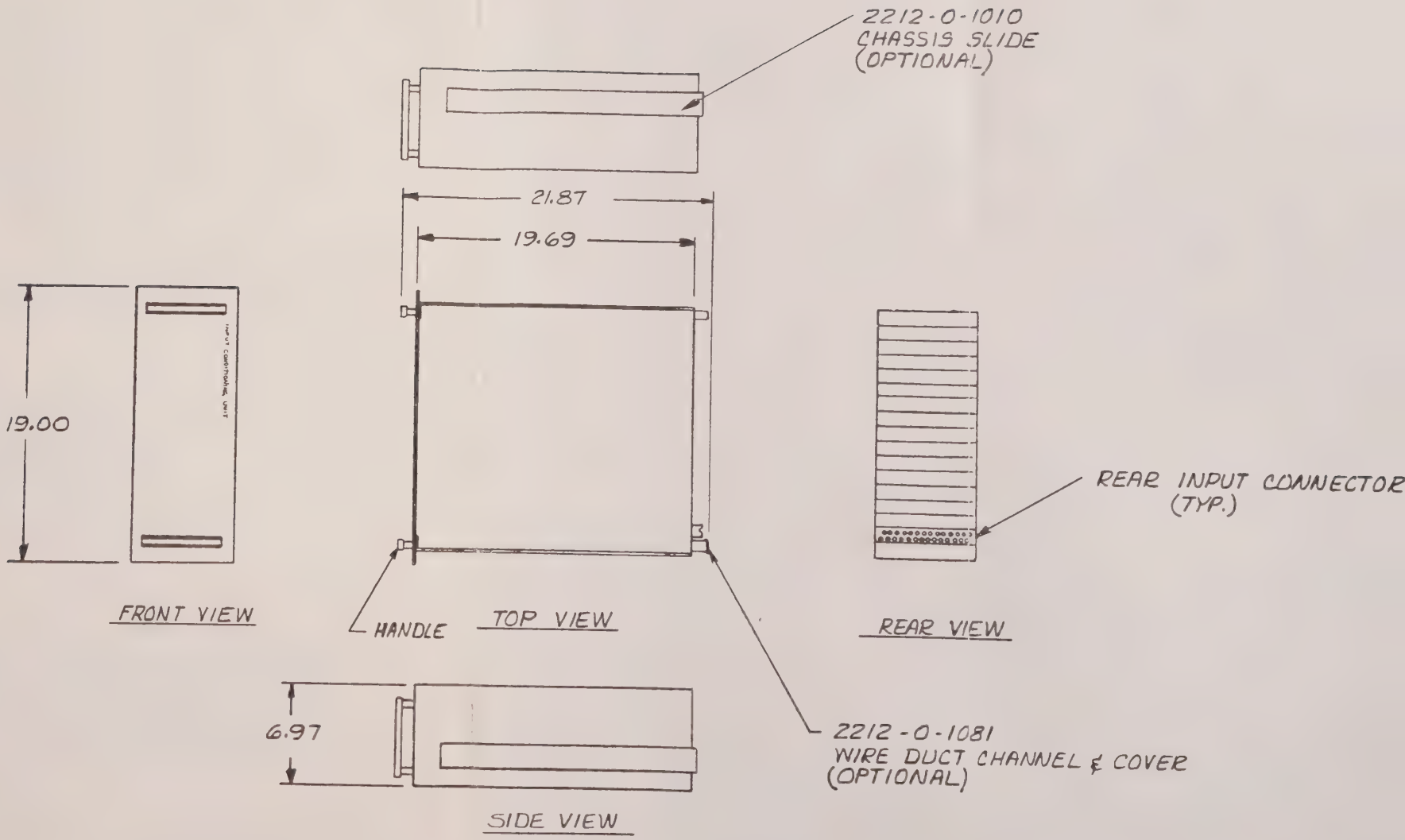

Figure 1-6. Input Conditioning Unit Chassis 2211-MC.

1.6.14 System Diagnostics

The SER contains specific instructions which extensively test and verify proper operation of many of its own components. Some of these tests continually take place while no event data is being serviced. Further, through its unique software organization, which permits expansion and variation, many of its individual initialization and test routines may be executed from the keyboard. In many cases, this availability will aid in troubleshooting and minimize down time.

The ongoing diagnostics and the flexibility of the system's operating software will, in many cases, determine a problem, the extent of the problem, and take corrective action if needed and print a corresponding message.

1.6.15 Input Connections and Connectors

There are several different types of input connectors available. The type will vary as a function of input board. The style may vary as a function of wiring techniques.

Model No.	Description
2211-O-233	Screw type (6-32). Dual staggered 14 position. Capable of accepting up to a 10 GA wire. Used for 4-channel threshold and 8-channel boards.
2211-O-234	Screw type. Dual Row. Used for 32 Channel Boards.

1.6.16 Ground Fault Detector

The ground fault detector senses current flow from either side of the field contact supply to ground. Either of the two relays (depending on the side of the supply, + or -) provides a relay contact closure when the trip current is exceeded. The relay remains closed until the current is reduced below the fault condition. Ground fault detectors are available for a 125 VDC supply (Model No. 2211-O-1023D).

1.6.16.1 125 VDC Ground Fault Detector

Similar to 24 VDC Ground Fault Detector (Internal impedance, 3 kilohms to ground, each side)

1.6.17 Alarm Contact Relay

An 8-function alarm contact relay board Model No. 2211-O-401 can be used in place of any size system. It allows the user to externally monitor certain events going on within the SER, as defined in Table 1-6. The relays are either pulsed on-off, or held on continuously, depending on definition. The pulsed on-off time is customer selectable and factory set to 1, 3, or 10 seconds. Refer to Table 4-5 for relay contact ratings and application notes with respect to inductive loads.

1.7 STANDARD ACCESSORIES

a. Two (2) 3-wire AC line cords (supplied with each Event Processor).
b. Three (3) rolls of printer paper P/N 102714 (supplied with 2210-MPT SER).
c. One (1) package of printer cleaning strips P/N 103418 (supplied with 2210-MPT SER).
d. Instruction Manual TM-103700 (Vol. 1).

1.8 FACTORY REPAIR

When factory repair is desired, proceed as follows:

1. Contact Dranetz Service Corporation in order to obtain an Authorization Number for factory repair.

   Telephone No: (201) 755-7081

   TWX: (710) 997-9553

   Telex: 499-7808

   Cable: DRANETZ

2. Fill out the REPAIR/SERVICE ORDER form enclosed in this manual. Ship it along with the malfunctioning equipment to Dranetz Service Corporation.

Table 1-6. Relay Definitions

Relay #	Name	Type	Turn on Time	Special Conditions
1	Change of State	Pulse	Any change of state, activated at time of event (within 1 msec).	none—all input points will be able to enable relay.
2	Special Character	Pulse	An ALARM EVENT for any input properly programmed with special character for input descriptor, at time of printing event data	: must be used as first character of input descriptor for that input.
3	Event Printout	Pulse	Any ALARM event at time of event printout, unless special character sequence is used in descriptor memory.	:: will disable the input from activating relay, if used as first two characters of descriptor for that input.
4	Diagnostic Message	Pulse	When any of the five diagnostic messages are printed.	None.
5	Inhibit Print	Continuous	When unit is in inhibit print, the relay will stay on.	None.
6	Printer Paper Low	Continuous	As long as printer paper is low and printer is on, this relay will be on.	None.
7	Unit Operational	Continuous	Proper System Operation will continually enable the relay (i.e., program lock-up, power supply failure, etc.)	None.
8	Single Point Test	Pulse	Once every hour on the half hour, unless system is busy from XX:30:00 to XX:40:00.	Note: If hooked up to input channel, the special character sequence will allow relay #3 not to be activated by this.

SECTION II

INSTALLATION AND OPERATION

2.1 GENERAL

This section contains the installation and operating procedures for the SER.

2.2 UNPACKING

2.2.1 Chassis/Cabinet Combination (See fig. 2-1.)

Unpack the equipment as follows:

1) Cut sealing tape on top surface and ends of outer carton and open outer carton flaps.

2) Lift inner carton off four (4) foam blocks glued to corners of outer carton.

3) Cut sealing tape on top surface and ends of inner carton and open inner carton flaps.

4) Lift top edge of exposed crease sheet.

5) Lift front-of-chassis foam protector out of inner carton, then carefully remove SER unit.

2.2.2 Chassis Only (See fig. 2-2.)

1) Perform steps 1) through 3) of par. 2.2.1.

2) Remove top and side foam pieces that encase taped tube in inner carton.

3) Carefully cut tape and remove chassis.

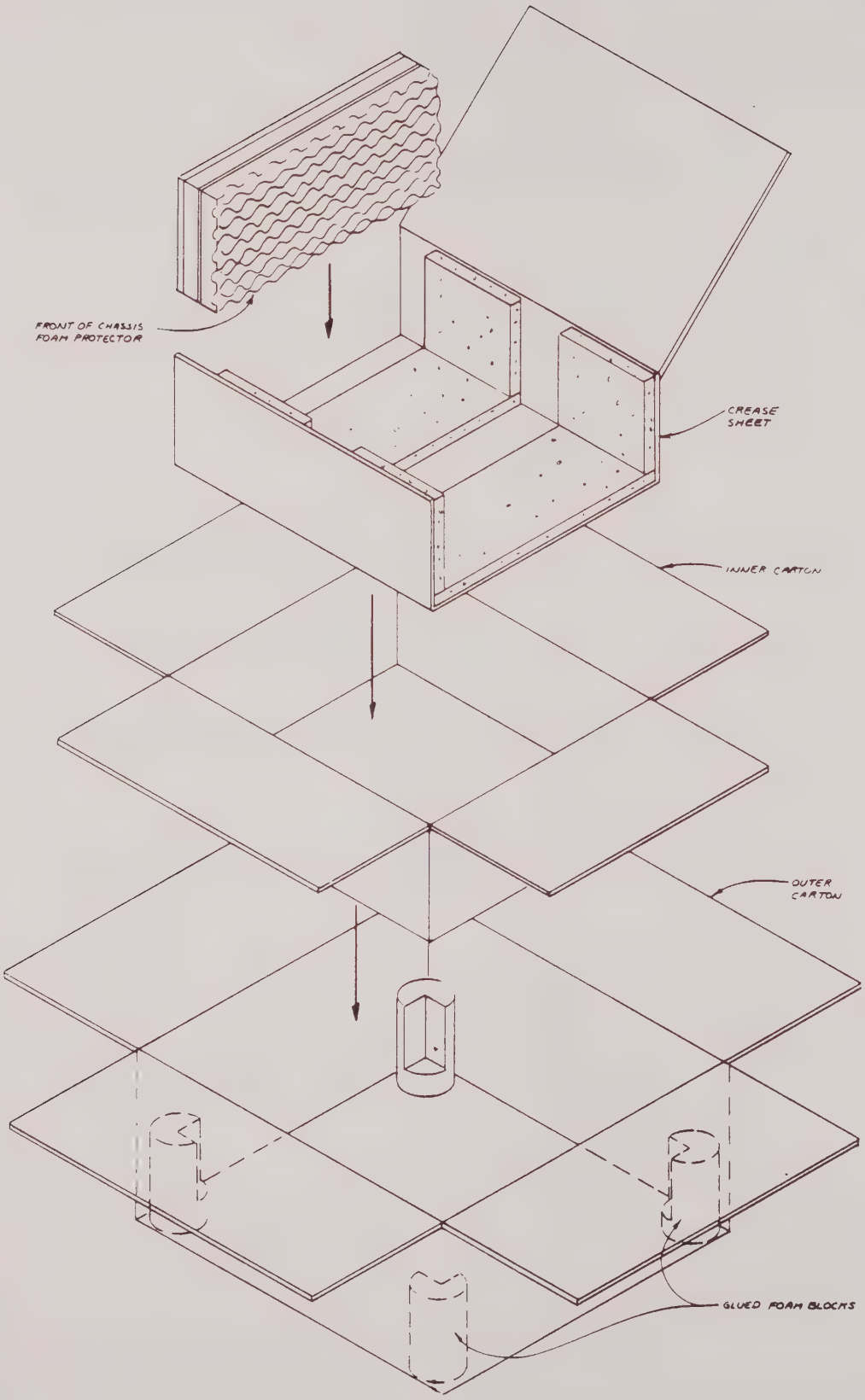

Figure 2-1. Chassis/Cabinet Packaging

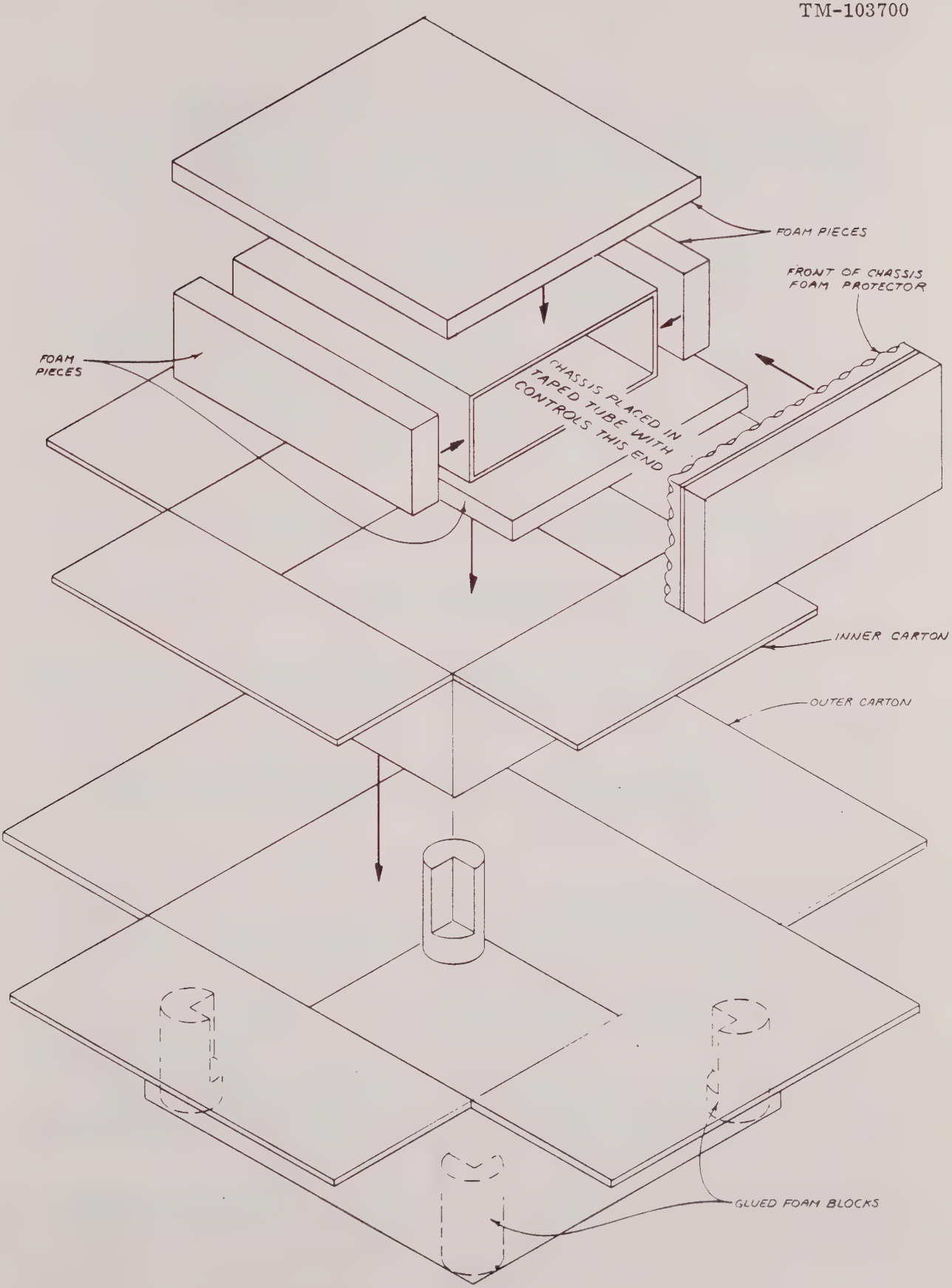

Figure 2-2. Chassis Packaging

2.3 PHYSICAL ASPECTS OF A SYSTEM 22 CONFIGURATION

Since there are many options available with System 22, along with a wide variety of system sizes possible, it becomes impossible to describe each particular configuration. However, with a few basic rules, set-up of the System 22 is very simple.

The general guides to be followed are listed below.

1) Daisy Chain Rule: Interconnections from the Event Processor to each Input Conditioning Unit (ICU) are made through a 60-conductor ribbon cable. The interconnectors start at the Event Processor unit and connect to each ICU. (Refer to figure 2-3.) Under no circumstances should a closed loop be formed. A one to one connection must be maintained. Do not attempt to twist or distort the ribbon cable.

2) The Event Processor should be positioned in a convenient location for the user/operator. This is generally shoulder height for rack mount installations.

3) Each mainframe (Event Processor and ICU) should be properly grounded to earth. (The station ground bus is preferable.)

4) 3-1/2" or 1-3/4" spacing should be maintained between mainframes. This allows for wire access and maintenance. (Filler panels are available from factory.)

5) A ribbon cable bus terminator (P/N 110462) is supplied with each Event Processsor. The terminator should be installed on the last Decode Board at the end of the ribbon cable.

2.4 SYSTEM SET-UP

2.4.1 Physically mount all mainframes as described in par. 2.3. (Do not interconnect mainframes at this time.)

2.4.2 Panel Assignment Numbers

For maximum efficiency with respect to system operation and memory utilization, sequential board numbers should be assigned. Panel number assignments are made via the Model 2210-O-140 Decode Board in each ICU and in Event Processors equipped with Input boards.

In a simple 32 input channel configuration, four Input boards and a Decode board are installed in the Event Processor. (See A, figure 2-3.) The Decode board is set to panel #01.

Consider a 96 input channel system. (Refer to B, figure 2-3.) In this 12 Input board configuration, the ICU was chosen to be panel #01 (board numbers 1 through 8) and the Event Processor was selected to be panel #02 (board numbers 9 through 12). This arrangement results in 12 sequential board numbers.

Consider a 128 input channel configuration. (See figure 2-4.) In this configuration, the best arrangement is as shown. It minimizes the amount of hardware (otherwise the Event Processor would require an additional Decode board). This also permits the Input boards to be assigned consecutive numbers by the operating software.

Similar considerations apply to 32 channel Input boards.

Board numbers are determined by the ICU's which are assigned panel numbers. The panel numbers are dip switch selectable on each associated Decode board.

Verify that all decode boards (one per each ICU and one optional for Event Processor) are selected for the desired system panel number. Selection is made by a binary switch pattern (S1) located on each Decode board.

NOTE: Under no circumstance should assigned number be duplicated in a given system.

Table 2-1 shows how switch S1 on the Decode board should be set to assign system panel numbers. Figure 2-5 identifies the switch segments.

NOTE: Panel assignment will be performed by the factory in system testing. Each unit will be identified accordingly. If in doubt, follow the above procedure.

2.4.3 Removal of Decode Board from ICU

In order to verify or select the panel number for a Decode board, the board must be removed from the frame. To remove the Decode board from an ICU, proceed as follows:

a) Remove the 1" x 7" filler panel (or field contact supply if so equipped). Facing the rear of the unit, the filler panel is located on the extreme right-hand side.

b) Remove the securing hardware and connector of the Input board which is adjacent to the filler panel. Remove the board.

c) Verify that the interconnect cables (60 conductor type) are not attached.

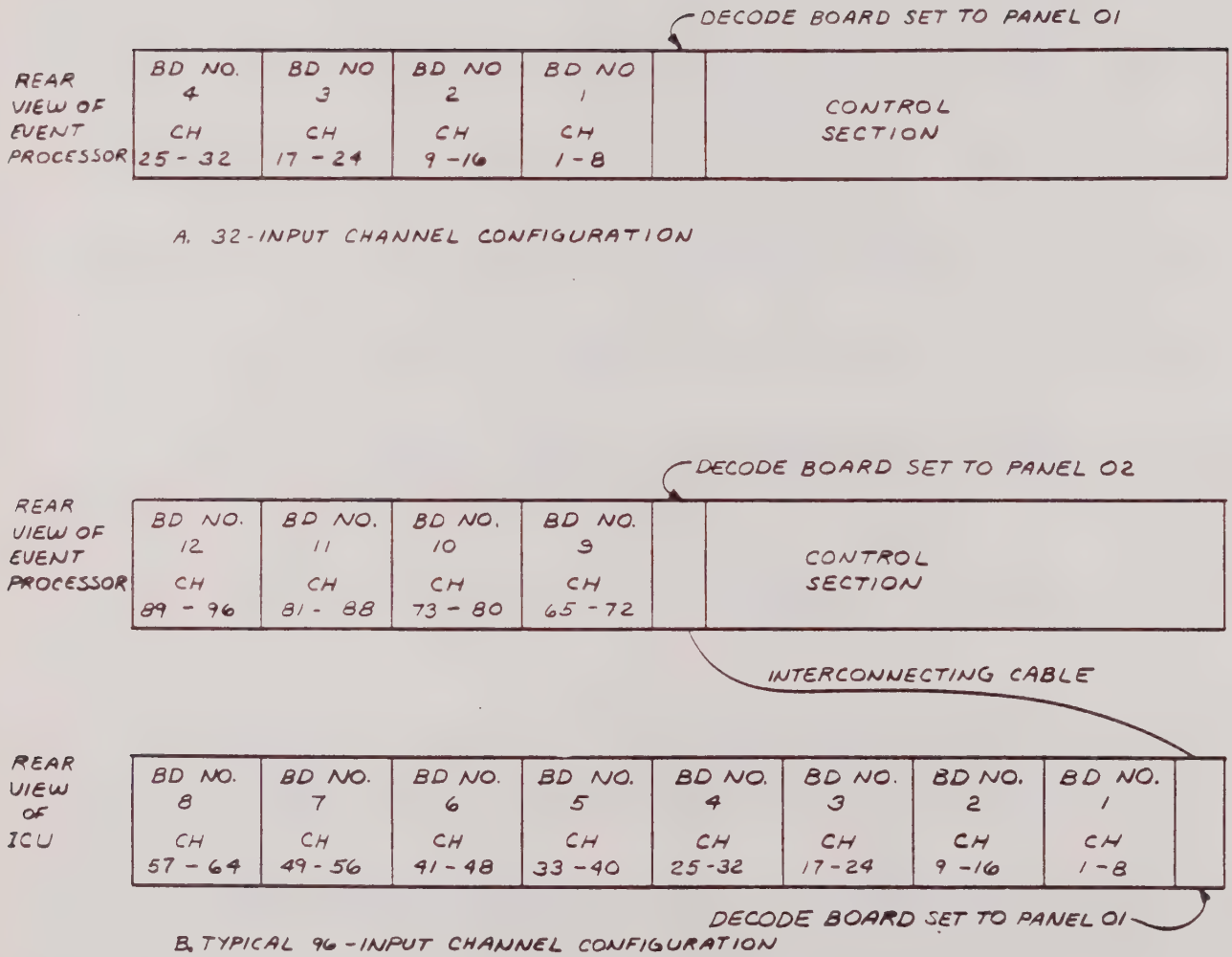
DECODE BOARD SET TO PANEL 01
REAR VIEW OF EVENT PROCESSOR
BD NO. 4 CH 25 - 32
BD NO 3 CH 17 - 24
BD NO 2 CH 9 -16
BD NO 1 CH 1 - 8
CONTROL SECTION
A. 32-INPUT CHANNEL CONFIGURATION
DECODE BOARD SET TO PANEL 02
REAR VIEW OF EVENT PROCESSOR
BD NO. 12 CH 89 - 96
BD NO. 11 CH 81 - 88
BD NO. 10 CH 73 - 80
BD NO. 9 CH 65 - 72
CONTROL SECTION
INTERCONNECTING CABLE
REAR VIEW OF ICU
BD NO. 8 CH 57 - 64
BD NO. 7 CH 49 - 56
BD NO. 6 CH 41 - 48
BD NO. 5 CH 33 - 40
BD NO. 4 CH 25 - 32
BD NO. 3 CH 17 - 24
BD NO. 2 CH 9 - 16
BD NO. 1 CH 1 - 8
DECODE BOARD SET TO PANEL 01
B. TYPICAL 96-INPUT CHANNEL CONFIGURATION

Figure 2-3. Typical 32 and 96 Input Channel Configurations Using 8-Channel Input Boards

REAR VIEW OF EVENT PROCESSOR

DECODE BOARD SET TO PANEL 01

BD NO. 8	BD NO. 7	BD NO. 6	BD NO. 5	BD NO. 4	BD NO. 3	BD NO. 2	BD NO. 1	
CH 57-64	CH 49-56	CH 41-48	CH 33-40	CH 25-32	CH 17-24	CH 9-16	CH 1-8	

REAR VIEW OF ICU

DECODE BOARD SET TO PANEL 02

BD NO. 16	BD NO. 15	BD NO. 14	BD NO. 13	BD NO. 12	BD NO. 11	BD NO. 10	BD NO 9	
CH 121-128	CH 113-120	CH 105-112	CH 97-104	CH 89-96	CH 81-88	CH 73-80	CH 65-72	

REAR VIEW OF ICU

Figure 2-4. Typical 128 Input Channel Configuration

Table 2-1. Decode Switch Settings for Panel Numbers 1-16

Input Panel Number	S1 Switch Setting				8-Channel System Input Number		32-Channel System Input Number	
	A3	A2	A1	A0	From	To	From	To
1	N/C	N/C	N/C	N/C	001	064	0001	0256
2	N/C	N/C	N/C	N/O	065	128	0257	0512
3	N/C	N/C	N/O	N/C	129	192	0513	0768
4	N/C	N/C	N/O	N/O	193	256	0769	1024
5	N/C	N/O	N/C	N/C	257	320		
6	N/C	N/O	N/C	N/O	321	384		
7	N/C	N/O	N/O	N/C	385	448		
8	N/C	N/O	N/O	N/O	449	512		
9	N/O	N/C	N/C	N/C	513	576		
10	N/O	N/C	N/C	N/O	577	640		
11	N/O	N/C	N/O	N/C	641	704		
12	N/O	N/C	N/O	N/O	705	768		
13	N/O	N/O	N/C	N/C	769	832		
14	N/O	N/O	N/C	N/O	833	896		
15	N/O	N/O	N/O	N/C	897	960		
16	N/O	N/O	N/O	N/O	961	1024		

NOTES

Input Conditioning Unit panel numbers 5 through 16 do NOT apply for any system that uses a 32-channel type board.

An 8-channel system is defined as any system that does not use a 32-channel board.

A 32-channel type system is defined as any system that uses a 32-channel board.

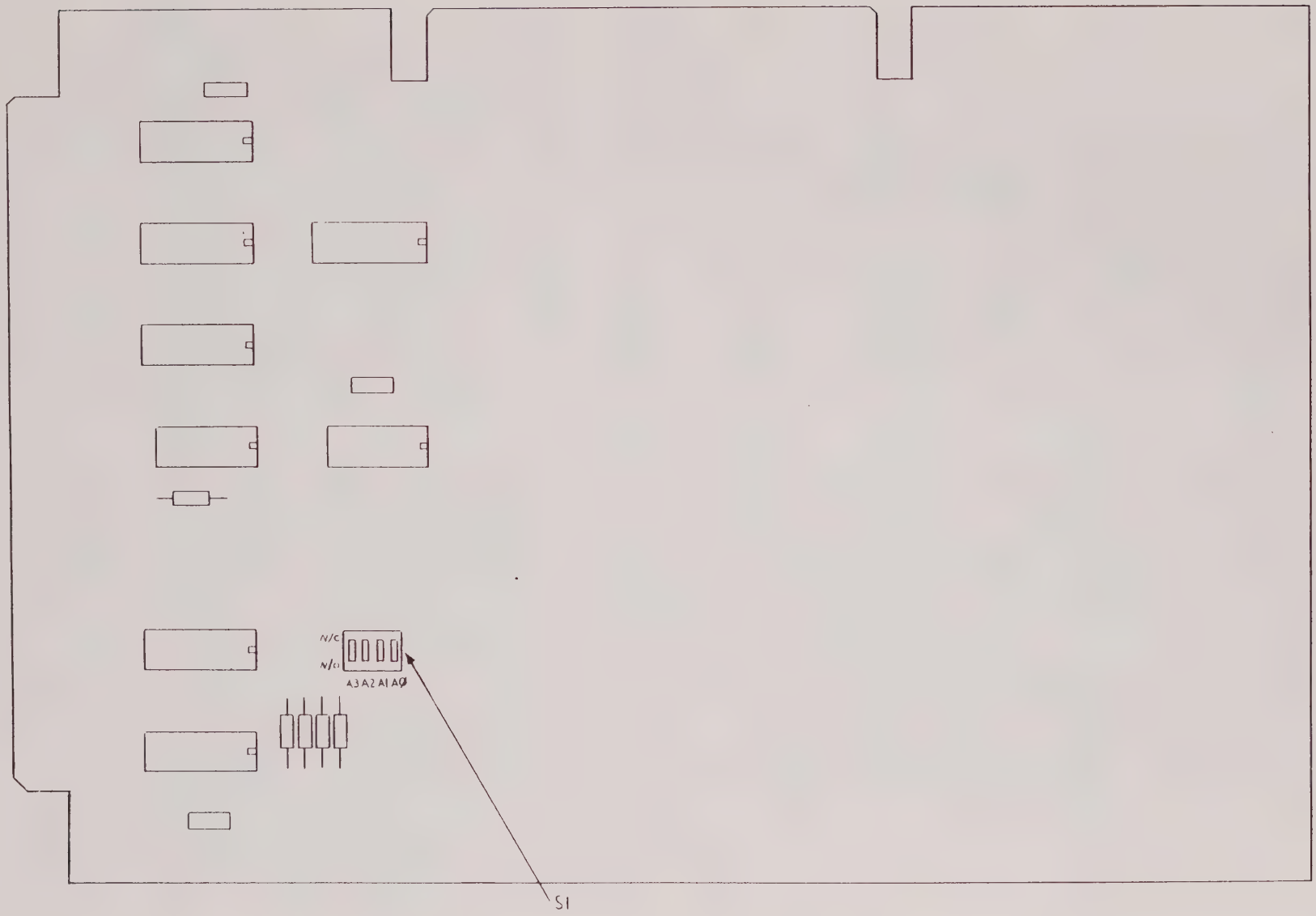

Figure 2-5. Decode Board Binary Switch Pattern

d) Disconnect decode braid wire from frame.

e) Remove the Decode board and shield assembly.

f) Remove the shield (4 screws)*.

2.4.4 Removal of Decode Board from Event Processor

a) Remove 1" x 7" filler panel (or field contact supply if so equipped) located at the center rear of the unit.

b) Remove the back plate (six screws).

c) Remove the real time extender board (the ground wire may also have to be disconnected).

d) Remove the shield and retainer plate (six screws).

e) Remove the connector and securing hardware of the first Input board (if so equipped). Remove the board.

f) Disconnect the braid ground wire of the Decode board shield from the frame.

g) Verify that no interconnect cables are attached and, if so, remove.

h) Remove Decode board assembly.

2.4.5 (Re)connect the cables to each ICU and Event Processor as described in par. 2.3.

2.5 DESCRIPTOR BOARD SET-UP

The SER's descriptor memory board contains several switches which must be properly set for the unit to operate. The SER program resides on the board in PROMs as well as the system RAM. The switches associated with the program PROMs and system RAM are dip switches S1 and S2. For proper operation, the switches must be set up as shown in Table 2-2 below. The rotary switch S3 is used by the SER to interpret the number of characters per descriptor legend. Refer to the table below for a list of all possible switch settings and the associated descriptor lengths. Switch S4 is a four switch rocker type used by the CPU to set its mode of operation. This switch can disable the Accumulator features as well as the Process Analyzer features**. The switch also is used to tell the CPU what type of EEROM chips are on the Memory Matrix Board, and which Real Time board is in the mainframe slot. All switches and the functions are shown in the tables below.

*A cutout in some shields enables switch setting without removing shield.

**Process Analyzer features consist of TRAP's, OUT OF TIME and OUT OF SEQUENCE. (Refer to Section III, Special Features.)

Table 2-2. Descriptor Board Switch Settings

S1: PROM Enable switch

SWITCH #	CKT	ON/OFF
1	BSF	ON
2	BSE	ON
3	BSD(BS8)	OFF **
4	BSC	ON
5	BSB	ON
6	BSA	ON
7	BS9	ON
8	BS8	ON

S2: RAM Enable switch

SWITCH #	CKT	ON/OFF
1	BS7	OFF
2	BS6	OFF
3	BS5	OFF
4	BS4	ON
5	BS3	OFF
6	BS2	ON
7	BS1	ON
8	BS0	ON

S3: Characters per legend:

SWITCH POSITION	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
CHAR/DESC	0	8	16	24	32	40	48	56	64	72	80	88	96	104	112	120

S4: Operating mode selection:

SWITCH #	ON	OFF
1*	Enable Process Analyzer	Disable Process Analyzer
2	60 Hz Real Time board	BCD Real Time board
3	2815 EEROMs	2816 EEROMs
4	Accumulators enabled	Accumulators disabled

*Process Analyzer features consist of OUT OF TIME and OUT OF SEQUENCE. Refer to Section 3, Special Features.

**On for gate analysis software operation and some factory test software only.

2.6 BCD REAL TIME BOARD SET-UP

The real time board contains several user definable switch jumper settings. The board also contains a precision oscillator module which generates a controlled 1kHz signal which is the basis for much of the unit's timing. In addition to the system's real time clock, the module also generates the debounce frequency signal for the input boards and the accumulator real time interrupt.

The debounce frequency is user definable by jumpers on the post assembly W1 located at the top of the board. The jumper will be factory set for a 4 mSec debounce period. Refer to table 4-9 for the user selectable debounce periods.

Post assembly W2 is located below the two slide switches S1 and S2. This assembly sets the real time interrupt. This is NOT a user definable quantity. It is responsible for the SER time accumulators, and they are dependent on the setting being one second. Under no circumstances should the setting of this jumper be changed. There is a provision made to allow the "watchdog" reset to be disabled using slide switch S3. This capability may be useful during system testing or troubleshooting. The switch should be "ON" at all times to ensure that the SER's constant monitoring of points is preserved. The reset circuit also ensures a clean start-up when power is applied.

The last user definable function has to do with the external time code usage. If a time code generator is not going to be used, switch S1 (refer to PC layout) should be in the "off" position. If the user intends to use an external time code generator which provides the required signals, then switches S1 and S2 must be preset as a function of the desired time operation. The switches are defined in Section 4. In addition to the Real Time board, the Real Time Extender board contains a 4-circuit DIP rocker switch which may be set up by the user. This switch which pertains to the external time base, is also described in Section 4.

In the event that an hourly pulse is going to be used to synchronize the SER time clock, the connector for this input is provided on the Real Time Extender board. The connector is a 3-terminal block. The top screw connector is for the positive side of the signal; the bottom screw is for the negative side.

2.7 BAUD RATE SET-UP

The CPU Board contains a baud rate generator that is capable of up to sixteen different frequencies. The rotary switch (S1) selects the proper rate. The baud rates that are possible are as listed in table 1-4. Figure 2-6 shows the position of S1 on the CPU board assembly.

NOTE: The SER normally outputs serial data at or near the selected baud rate; however, inputted data to the SER may require special consideration. In other words, when the SER transmits a message, each character follows the preceding character without substantial delay. Inputting characters are handled differently. The input software routine is multiplexed with various other overhead functions. If characters are transmitted at a rate faster than the software can handle, missing characters will result. This condition is not a function of the baud rate, but rather a function of the SER processing time. Normally, this is not a problem except when interfacing the SER with some types of computers or high speed peripherals at baud rates greater than 300.

2.8 EXTERNAL SYSTEM WIRING

2.8.1 Power Supply (AC and DC)

System 22 will operate from either 115/230 VAC 47-63 or 120/240 volt DC* station battery. Both side of the AC line are fused internally on the transfer board; likewise, so are the DC input terminals. It is not necessary to connect both sources. A 3-wire type AC line cord is provided with each Event Processor. The cord is connected to the SER at the rear of the Event Processor (lower right hand corner of the rear plate as shown in figure 2-7). The DC source (station battery) is connected to the terminal block located in the upper right hand corner of the rear panel. A cover is provided for the terminal block.

An external method of disconnecting station battery may also be desired (a circuit breaker or switch). This may aid in system trouble-shooting and provides an additional degree of redundant safety when wiring.

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*2210-O-320 Power Supply - Refer to power supply specifications for other ranges.

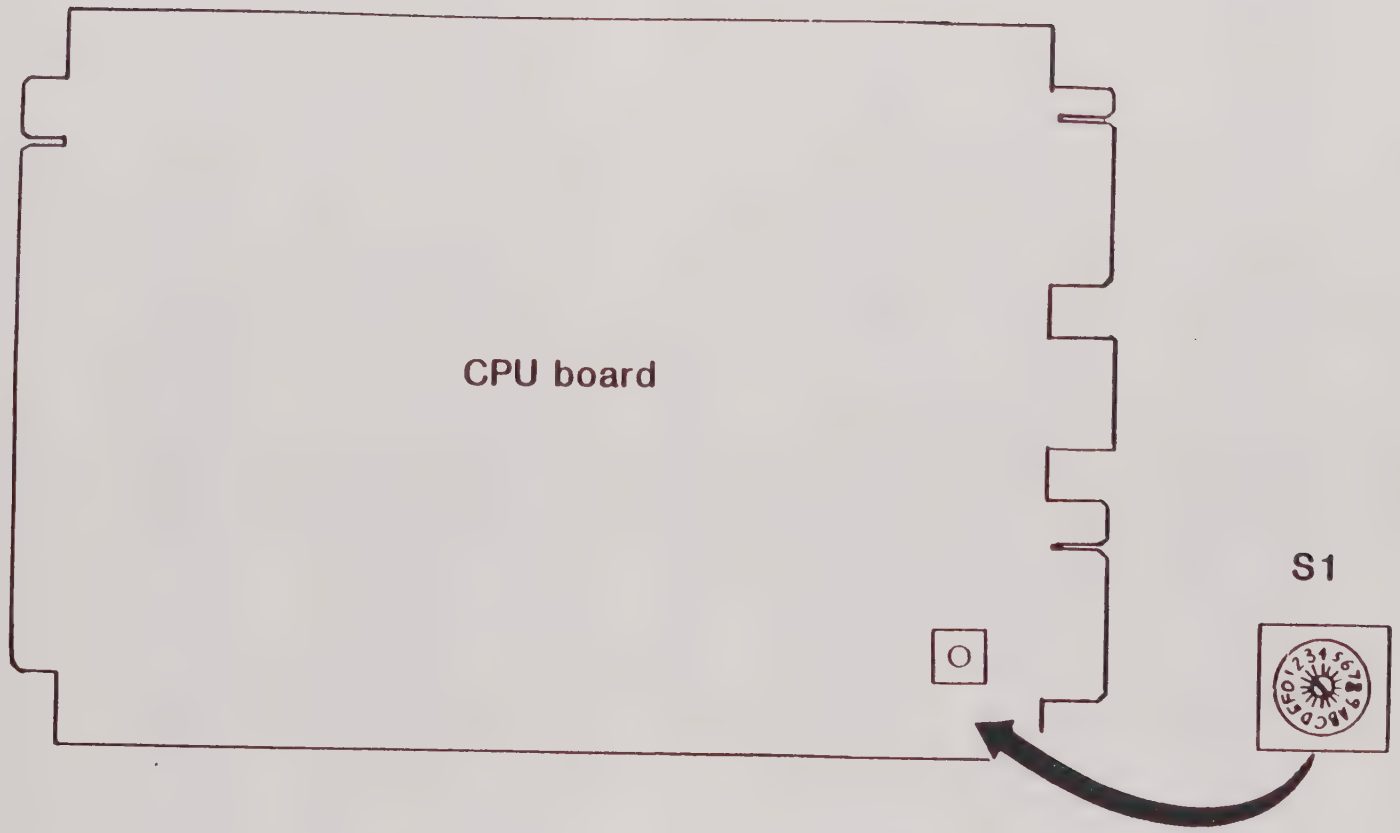


Figure 2-6. Location of S1 on CPU Board

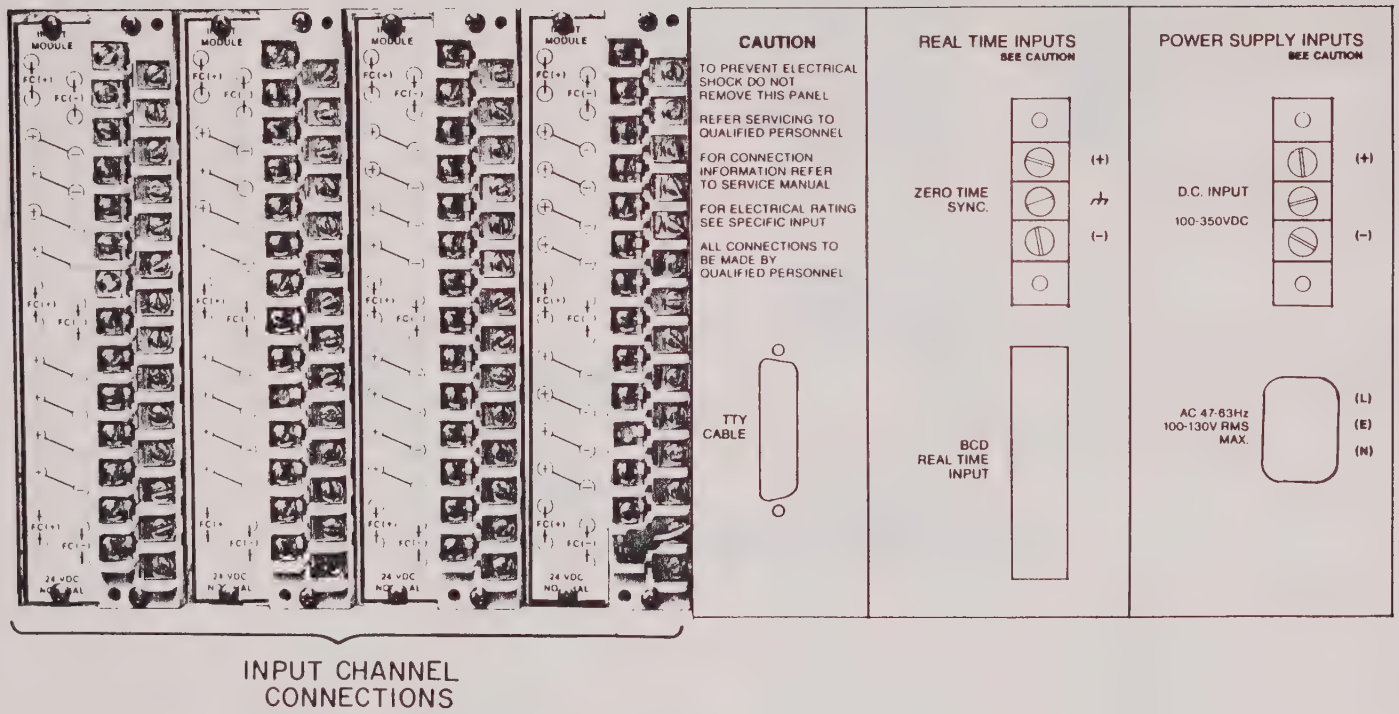


Figure 2-7. Event Processor Rear Panel

2.8.2 Zero Time Sync

This input is also located at the rear of the Event Processor. (See figure 2-7.) Connections are made via a screw type terminal block protected by a cover. The center terminal, frame ground, should not be used.

2.8.3 Remote RS232C Port (Teletype Cable)

Connection to the remote terminal is made via the 25 pin connector at the rear of the Event Processor. (See figure 2-7.) The Dranetz interconnect cable (figure 1-2) should be used. It provides the special printer failsafe connections that allow the SER to detect remote failures and paper conditions. Special filtering is also incorporated into the Dranetz cable.

2.8.4 Input Channel Wiring

Connections to the isolated input channels can be made in several ways. All methods are based on the same concept. The input channel is a two terminal connection which requires the application of a potential for activation (closed) and the removal of the potential for deactivation (open). The SER considers either of these two conditions as a change in state. Refer to Section IV for specific details on wiring the various Input Boards available.

2.9 INSTALLATION OF THERMAL PAPER IN MODEL 2210-MPT SER (See fig. 2-8.)

CAUTION: Refrain from touching the roller mechanism at all times.

The 2210-MPT Event Processor is shipped with a roll of paper (DEL P/N 102714) already installed. During operation, when the paper supply becomes low, the unit will automatically print PRINTER PAPER LOW. Once a paper low condition is detected, the INH PRT function is initiated.

a. Open the paper door by releasing the two door latches. Pull outward. Do not attempt to pull latch out of door.

b. Using the ENTER key, generate a line feed (key switch in SET position).

c. Note that a PAPER LOW message is generated. On MPT units, this message will be displayed on odd seconds, with time displayed on even seconds.

d. Set key switch in OPER position.

e. Tear paper off just above old roll. Do NOT remove the paper strip that remains in the roller assembly at this time.

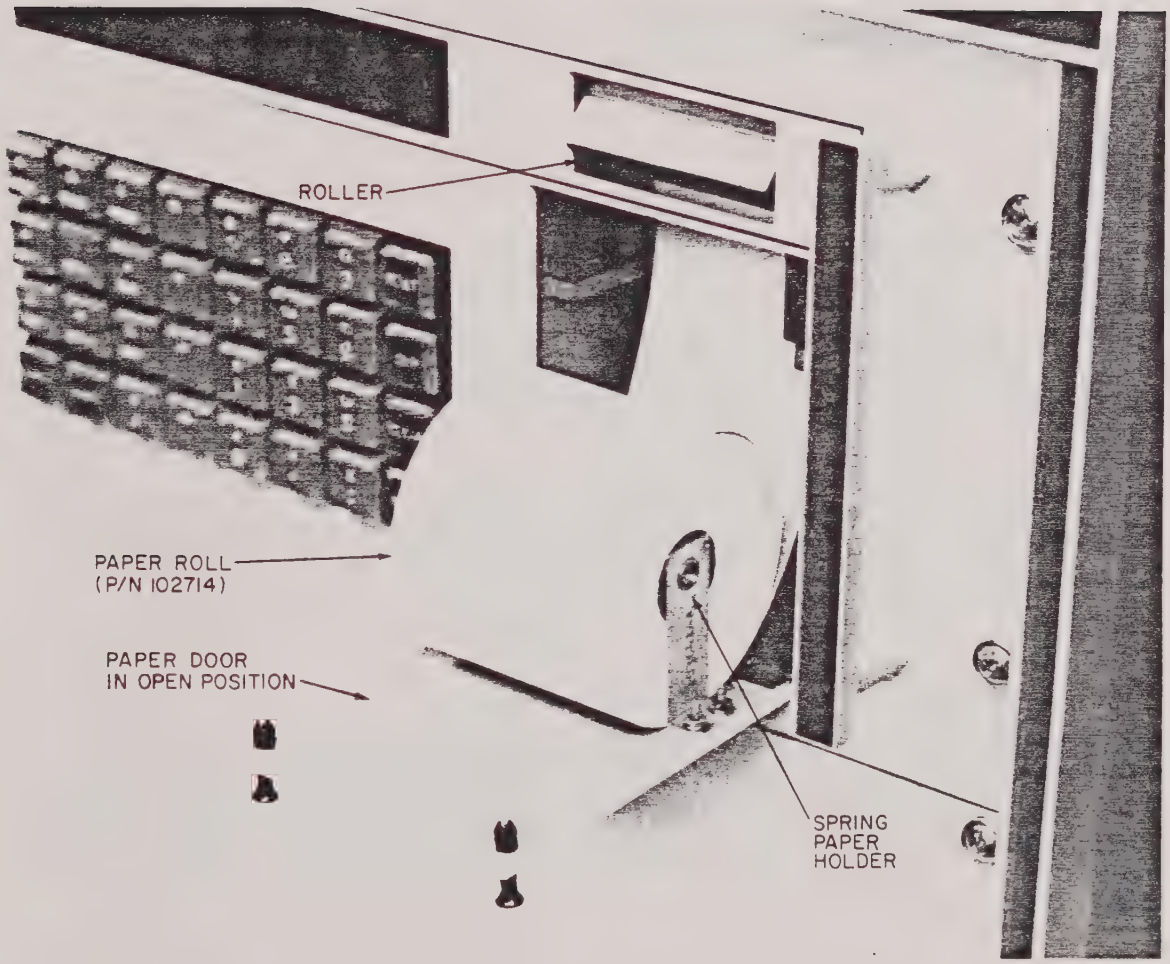


Figure 2-8. Installation of Thermal Paper

f. Push the two spring paper holders outward to release the old paper roll. Remove the old paper roll from the holder.

g. Remove the holding tab from the new paper roll to release the end of the roll. Use a scissor to cut the edge of the paper straight.

h. Install the new roll in the paper holder so that the paper unwinds from the bottom and feeds toward the printer assembly.

i. Position the new paper snugly between the roller and the old paper strip that was left in the roller assembly.

j. Set the key switch in the SET position. Enter several line feeds (ENTER) while guiding the new paper onto the roller. Continue this procedure until the new paper is visible at the paper cutting bar.

k. Carefully remove the old paper strip from the printer assembly and discard.

l. Enter several additional line feeds (ENTER) and verify that the new paper roll is advanced evenly. (If it is not, repeat the procedure from step e.) Additional paper low messages will be generated.

m. Close the printer door and latch it.

n Due to the paper low, the SER is in a suppression mode. The unit will automatically resume normal operation approximately 3 minutes after paper has been restored and the door closed. Pressing the SKIP key or entering Control C from a teletype (if present) will override this time out delay.

2.10 CLEANING PRINTHEADS

During the course of normal printer operation, minute particles of thermal sensitive material tend to be dislodged from the surface of the printer paper. These particles may accumulate on the surface of the heating matrix in the printhead. This causes a reduction in heat-flow to the paper causing the following symptoms:

Print density too light

No printout

Missing dots

A number of methods may be used to clean the printhead. In the simplest and preferred method, particles may be removed by inserting a length of bond paper (approximately 10 inches in length cut to width of 2.25 inches) into the printer and operating the printer until the length of paper passes through the printer. (Refer to par. 2.9.)

NOTE: For your convenience Dranetz has made available a precut paper strip (Dranetz P/N 103418). This paper serves as an abrasive which buffs the surface of the printhead clean. It is a recommended good practice to clean the printhead each time the thermal sensitive paper roll is replaced.

An alternate method, which provides a more thorough cleaning of the printhead, requires that the bond paper (manually cut to size, as described above, or Dranetz P/N 103418) be soaked in Anhydrous Isopropyl Alcohol and passed through the printer. The alcohol is generally available at a pharmacy. This cleaning method works by dissolving the accumulated particles in conjunction with buffing the surface of the thermal elements.

CAUTION: Do not use over-the-counter rubbing alcohol. This often contains subtle quantities of oil-base perfumes that will foul the printhead matrix.

2.11 OPERATING CONTROLS AND INDICATORS (See figures 2-9 and 2-10)

The control panel of both SER models contains a key-operated mode switch. In the OFF position, power is off and key is locked. In the OPER position, power is applied to the system and the key may be removed, but the front panel keyboard (Model 2210-MPT) and pushbutton switches (Model 2210-MP) as well as the keyboard of the remote terminal (RS232C port) are inoperative. In the SET position, power is applied, the keyboard and pushbutton switches are enabled and the key is locked.

The functions of the special keys on the front panel keyboard of the Model 2210-MPT and the pushbutton switches on the Model 2210-MP are described in Section V.

2.12 OPERATIONAL DESCRIPTION

To obtain maximum use of the features incorporated in the SER, the operator should be thoroughly familiar with all system commands and their implementation. In the Model 2210-MPT, all operator/SER interface functions may be implemented via the front panel keyboard, alpha-numeric display and thermal printer and/or with a remote teletype. When using the Model 2210-MP, a remote teletype must be used. Table 5-1 lists all system commands.

2.12.1 Entry Modes

NOTE: For keyboard entry modes, either the ENTER key (Model 2210-MPT) or the carriage return (CR) on the remote teletype must be depressed before the command or response is accepted by the system.

Basically, all SER commands may be entered in one of three modes. Figure 2-11 indicates how a command is entered and executed in each of these modes, described below.

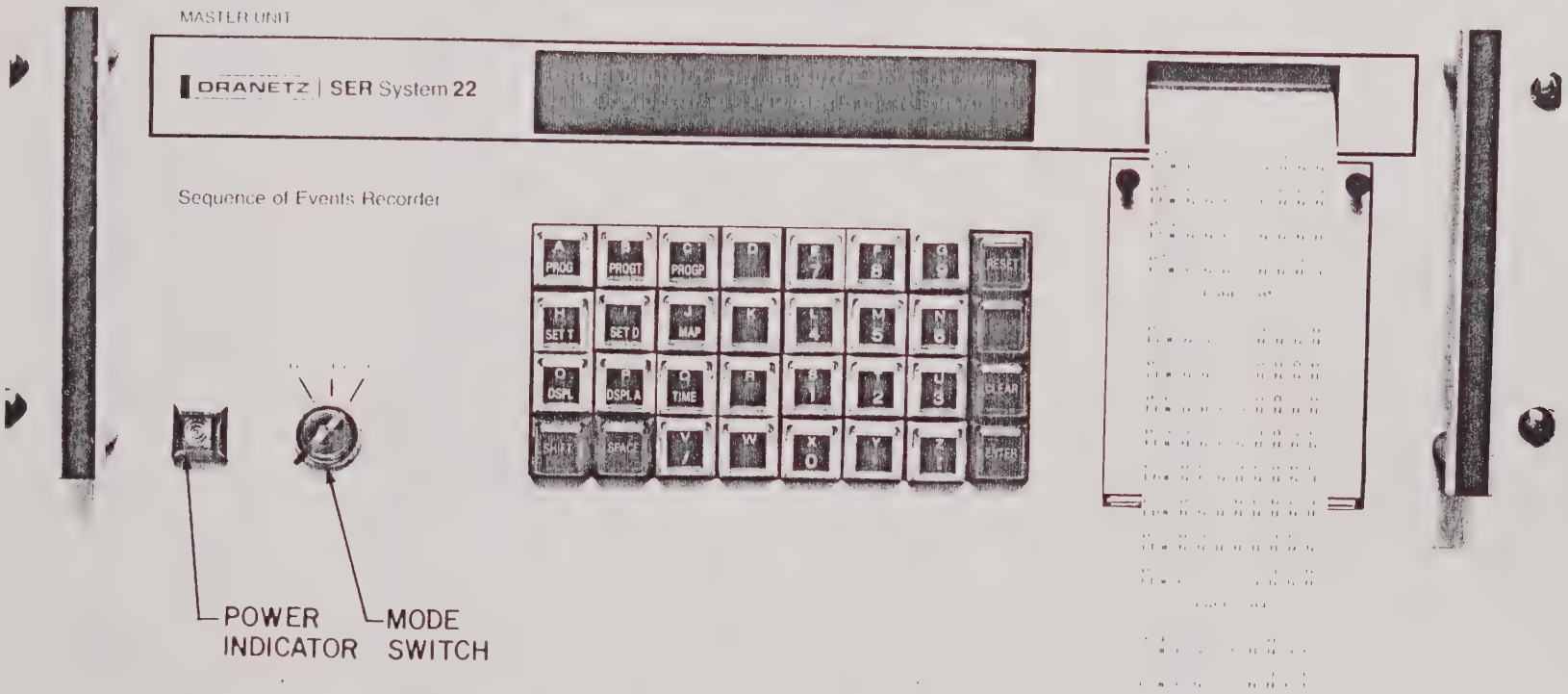


Figure 2-9. Model 2210-MPT SER, Front Panel

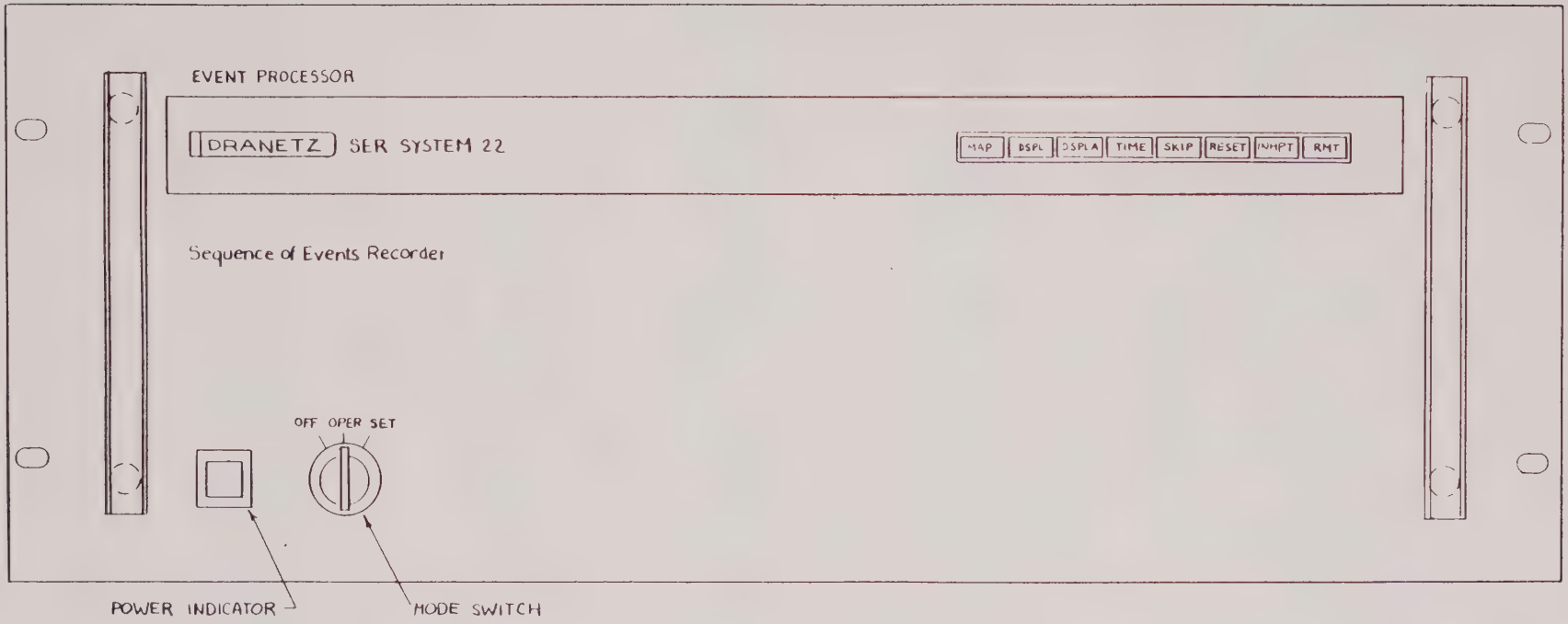


Figure 2-10. Model 2210-MP SER, Front Panel

2.12.1.1 Manual Keyboard Entry

In this mode, the command is typed by the user one character at a time. For the Model 2210-MP, a teletype keyboard is used; for the Model 2210-MPT, either a front panel keyboard or a teletype keyboard may be used. Once the command is entered (by depressing the ENTER key on the Model 2210-MPT or by the CR* on the teletype in either model), the system compares the command with an internally stored command table. If the command was entered incorrectly, the system responds by printing: WHAT? If the comparison proved the command to be valid, the flag corresponding to the entered command is set. During normal operation, the system examines the command flags. If any flag is set, that function is executed.

2.12.1.2 Automatic Keyboard Entry

This entry mode is available only on the Model 2210-MPT. Some keys on the 2210-MPT keyboard represent dedicated command functions. When one of these keys (such as PROG, PROGT and PROGP) is depressed, the system enters the command. From that point, the system response is the same as for the manual keyboard entry.

2.12.13 Pushbutton Command Entry

This entry mode is available only on the Model 2210-MP. Pushbutton switches on the control unit bypass the keyboard sections and set the associated function flags directly. Only certain of the command functions are implemented in this manner. All others must be typed on the terminal.

2.12.2 System Commands

Table 2-4 lists and defines all SER commands. For each command, the manual keyboard is shown exactly as it should be entered.

NOTE: Commands are described in Section V.

2.13 POWER ON AND SYSTEM INITIALIZATION

This section will exemplify a typical initialization of System 22. It is assumed that the operator is familiar with the system commands. In a sense, the following instructions represent the basic outline.

*Carriage return or return

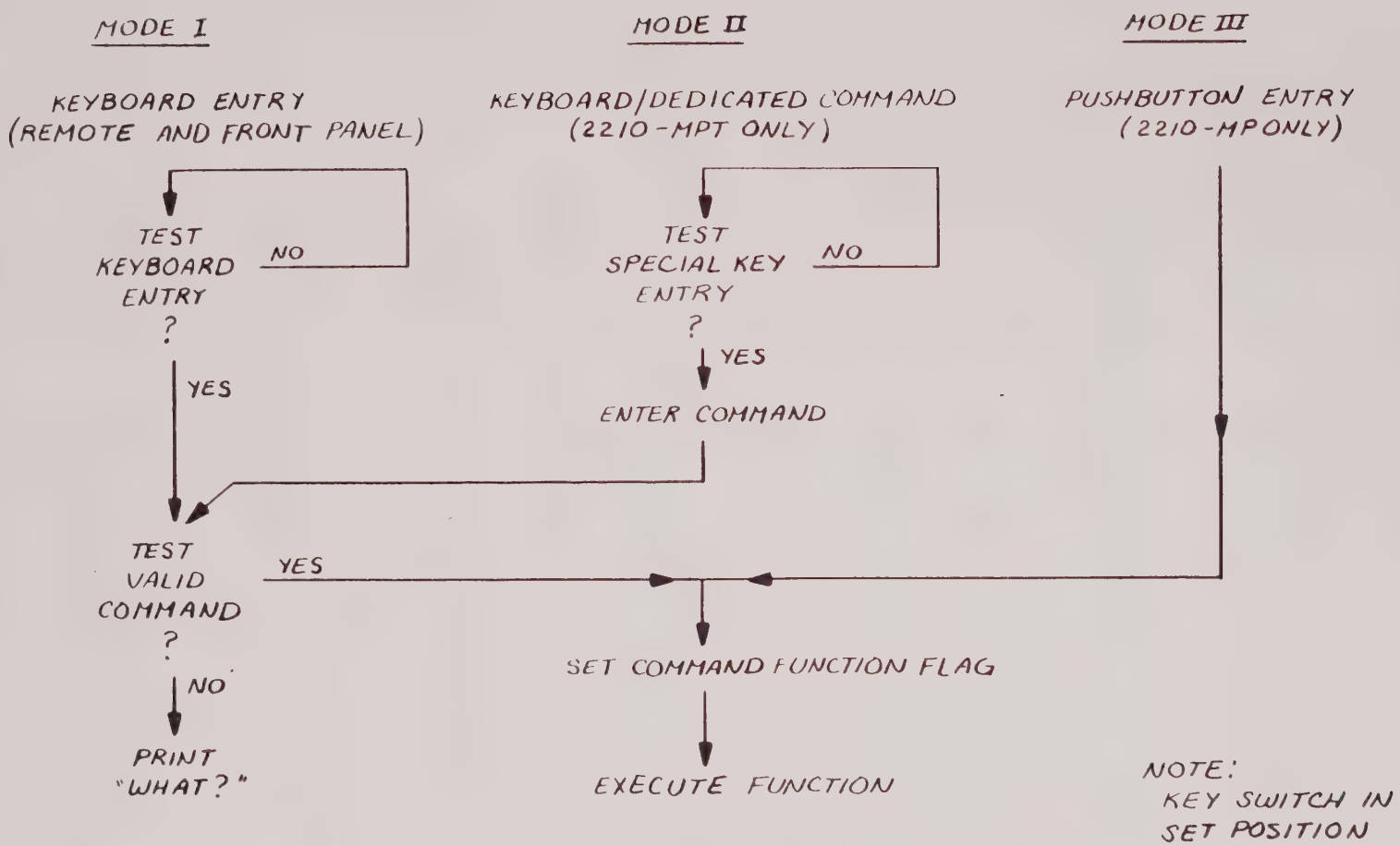


Figure 2-11. System Command Modes

2.13.1 Power On

a) Verify that all power sources are appropriately connected.

b) Set the key switch to the OPER position and verify that the "POWER ON" message is printed.

c) Verify that an adequate paper supply exists. (Refer to para. 2.9)

2.13.2 Set Time

Set the key switch to the SET position and set the present time.

2.13.3 Set Date

Set the present date, month/day/year.

2.13.4 Program Test

Program the descriptor text for each channel.

2.13.5 Program Polarity

Enter the normal state of each of the inputs (N/O or N/C).

2.13.6 Execute DSPL and MAPSYST commands for future reference.

2.13.7 Verify that data of par. 2.13.6 agrees with the present configuration.

2.13.8 Set the key switch in the OPER position and remove key.

SECTION III

SPECIAL FEATURES

3.1 SCOPE

The SER system 22 contains many special features which do not traditionally fall into event recorder specifications. This section defines these features.

3.2 SER FEATURES

The features outlined in this section represent the versatility of the System 22 software. The features are resident, as described, within the SER program. However, in some cases there must be hardware setup done prior to the execution of the programs. In the case of snapshot, selected monitoring, and prefault trigger, there is an option board which is required in addition to the standard mainframe. Out of sequence detection requires that an EEPROM be inserted in the socket for U7D on the expanded descriptor board. The addition of this chip will also expand Trap detection from 4 Traps (13 - 16), to the full complement of 16 Traps. Out of Time detection requires that an additional EEPROM be inserted into socket U6D. The use of these features obviously limits the descriptor memory to 59,392 characters, but this still represents a 56 character descriptor for each channel in a 1024 point system.

3.2.1 Out of Time Detection

This feature is a software routine that will calculate the difference in time between two events and determine if the time is within user programmable limits.

3.2.2 Out of Sequence Detection

This feature is a software routine that will determine if the occurring events are in a user programmable order. It also has the ability to LEARN the occurring sequence for subsequent cycles.

3.2.3 Trap Detection

A TRAP is a condition that exists when several channels are in a predefined state. There are 16 different programmable traps.

3.2.4 Snapshot

This feature enables the user to cause the SER to record all channels in the system as if they had changed state at the time of the trigger channel. This is useful when an overall view of the system is important.

3.2.5 Trigger Print and Prefault

This feature inhibits the printing of events until a predefined trigger event occurs. The event memory cannot overflow because at least 100 events levels are maintained for post trigger events.

3.2.6 Selected Monitoring

This feature enables the user to monitor events on a selective basis. When the select channel is active, no events are recorded. When the select channel is inactive, all events are recorded.

3.2.7 Accumulators

Elapsed Time: This feature maintains the duration for all channels that are active (on a channel-by-channel basis).

Transition Counters: These counters keep track of how many times a channel changes state.

Reoccurrence Counters: These counters keep track of how many times all channels appear in any one event sequence printout.

Event Accumulator (Line Counter): This counter is used to number all events that occur. This feature is useful for long term record keeping and machine utilization.

3.2.8 Channel Deletions

There are several ways to delete an individual channel from being monitored (recorded).

Manual - the operator enters a system command
Automatic - the system deletes a channel because of excessive recording in one of two user definable modes.
Return to Normal - only Alarm printing

3.2.9 Programmable Status Words

The SER usually uses the words ALARM and NORM to describe the state of a channel. There are two ways to change these words.

System Status Words - ALARM/NORM are changed on a system basis.

Channel Status Words - The system status words can be replaced for each channel by programming the new words into the corresponding channel descriptor.

3.2.10 Dual Descriptors

The SER's descriptor legends may be programmed such that there is a descriptor for the Alarm state and a different descriptor for the Normal state.

3.2.11 Station Identifier

The station identifier is a user programmable name. This name is printed when the SER first turns on and at the conclusion of an event sequence.

3.2.12 Binary Coded Decimal Real Time

This feature enables the user to supply the SER with the values used for the time of day. Milliseconds, seconds, minutes and hours are provided. (There are no provisions for entering the day.)

3.2.13 Special Descriptor Characters

There are special character sequences which may be entered into a channel descriptor which will further define the operation of the SER.

3.2.14 Front Panel Indicators

This feature provides the operator with a means to observe the present status of the SER. Conditions such as "Paper Low" are displayed on the front panel LED display.

3.2.15 Gate Analysis Software

This feature provides the means of generating logical gates within the SER event printout.

3.3 OUT OF SEQUENCE DETECTION

3.3.1 Purpose

Out of Sequence Detection is an operational mode for the SER. When operating in this mode, the unit compares the occurring sequence of events of its input channels with a preprogrammed sequence. The programmed sequence is entered by the operator either from the front panel keyboard, an external terminal (CRT or TTY) or by the cassette tape. Once the programmed sequence is entered, it is stored in solid state non-volatile EEROM memory. A program sequence stored in EEROM need not be re-entered after the unit is powered off. The program is maintained indefinitely or until it is changed by the operator.

3.3.2 Program Execution

In order to initiate the Out of Sequence Mode, the user must define a Trigger channel. Entering a Trigger channel does two things. First it defines a specific event to which the "Out of Sequence Mode" is synchronized; it also enables the Out of Sequence program which may be enabled or disabled without entering a trigger channel. However, a trigger channel must be defined and occur before the Out of Sequence program will begin to execute.* This is an important point to note (the reasons will become evident later in this discussion).

Under normal operation, the trigger channel will be the first event of the programmed sequence. Thus, sequence detection will begin at the first event of the programmed sequence. The detection program compares all subsequent events to those events in the programmed data. No event data is printed as long as the events correspond but they are maintained in memory. When a new cycle is started (defined by the trigger reoccurring), and no errors have been detected, the events are cleared from memory (not printed) and a cycle event counter is incremented. If the trigger channel occurs prior to the completion of the programmed sequence, an "INCOMPLETE CYCLE" error message is generated, indicating that the trigger occurred prematurely in the sequence. [Note: The trigger may only occur once in any sequence. Other events may occur multiple times.] This is also interpreted as being an "Out of Sequence" condition and the entire sequence is printed out. The printout information contains the actual time of occurrence (hrs:min:sec:msec), the channel number, the state OPEN/CLOSED and the alphanumeric descriptor. An "Out of Sequence" condition will also exist if any event occurs out of order or does not occur. In these cases, the entire sequence is also printed out. An "OUT OF SEQUENCE" error message appears at the point in which the out of sequence was detected. All subsequent events are printed until the trigger occurs.

3.3.3 New Sequences

Perhaps the most valuable attribute to the "Out of Sequence Detection" program is its ability to learn a new sequence. A sequence is "LEARNED" whenever an "OUT OF SEQUENCE" condition exists (i.e., premature trigger, events not corresponding). Once a sequence is "LEARNED", the occurring sequence of events is compared to both the

*The TRIG SEQ command used without a channel will assume that the first event in the programmed sequence is the trigger.

learned and the originally programmed sequences. The monitored cycles can vary from the PROG CYCLE to the LEARN CYCLE and vice versa with only a minimal printing occurring. "RETURN TO PROG CYCLE" and "RETURNED TO LEARN CYCLE" are the messages generated. Should an event occur that does not compare to either the LEARN or PROG sequences, an "OUT OF SEQUENCE" condition will exist and this new sequence will be learned in place of the previous one. (This sequence is also printed out.)

The ability to define the Trigger Event combined with the ability to learn a sequence of events has a significant advantage. In cases where a known good cycle can be generated or monitored, the operator need only define the starting event (the trigger) and the "Out of Sequence" program will learn the cycle automatically. At the completion of the cycle, the operator may execute a simple command that will take the learned cycle information and substitute it for the (non-existent) programmed cycle data (MOVLRN).

3.3.4 "Don't Care" Conditions

Another important feature of the "Out of Sequence Detection" is its ability to define events as "Don't Care" conditions. It is highly likely that there are events which will occur that are not part of a programmed cycle. These events may have nothing to do with the cycle but are monitored only in case there is an "Out of Sequence", or they occur as a result of timing conditions. In many cases, it is not important to know when a relay opened but only that it closed in sequence. All events may be defined (on an individual basis) as "Don't Care" conditions with respect to Out of Sequence. These events are ignored by the Out of Sequence detection program. They are only printed as a function of the Out of Sequence detection. In other words, the event enters the event memory and only gets printed if an "Out of Sequence" is detected. If no "Out of Sequence" occurs, they are deleted from event memory along with the sequence data. A note of caution - Programming an event into a sequence and as a "Don't Care" will result in an "Out of Sequence". Programming a sequence will clear all "Don't Care" events. Modifying the sequence has no effect on the "Don't Care" events. Also note that if a channel is "DELETED" and is part of the sequence data, an "Out of Sequence" will occur.

The maximum number of events in a sequence is 255 events. A "LEARN" sequence greater than 255 events will only learn the first 255 events. A repeat of that cycle will generate an "Out of Sequence" after the 255th event.

Traps are compatible with the "Out of Sequence" operation. However, they are subject to the same criteria as the "Don't Care" events. TRAP event data is only printed during an Out of Sequence condition. If the cycle is not out of sequence, any TRAP conditions are deleted from memory along with the cycle data. (For additional descriptions of TRAPS refer to para. 3.5.)

Two or more events occurring at the exact instant (1 millisecond resolution) is an unresolved condition and is likely to generate an out of sequence. There are some cases where simultaneous events are allowed. Certain "Don't Care" and deleted channels are permissable. The "Out of Sequence" detection is part of the interrupt routine and therefore has an effect on the event time resolution. For a single event occurring in a mainframe containing less than 64 channels, the event resolution remains one millisecond per 64 channels.

3.4 OUT-OF-TIME DETECTION

3.4.1 Purpose

The OUT-OF-TIME DETECTION is a program contained in the SER software. It provides a means of calculating the time between two events and determines if the difference is within preprogrammed limits. The operator must define the timing requirements. The following information must be programmed for each event:

1) Event
2) Reference
3) Time
4) Tolerance

3.4.2 Time and Time Tolerance

The programming procedures are not complicated and can be learned in a very short period of time. For the most part, the programming and modifying of Out of Time data is assisted by prompting and is therefore extremely easy to use. An EVENT is defined as a channel and a corresponding state (OPEN or CLOSED). The REFERENCE is also defined as a channel and a state. The TIME is the nominal time difference between the time of occurrence of the EVENT and the time of occurrence of the REFERENCE. The time can be expressed using seven digits in the form of either:

XX:XX:XX.X = HRS:MIN:SEC.TENTH OF SEC. (Long Time Format)

or

XX:XX.XXX = MIN:SEC.MILLISECONDS (Short Time Format)

The tolerance is the amount of tolerable error between the calculated difference of time and the programmed nominal difference. The Time Tolerance can be expressed using 5 digits in the form of:

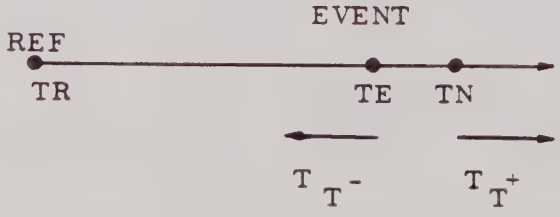
XX:XX.X MIN:SEC.TENTH of SEC (Long Time format)

or

XX.XXX SECONDS.MILLISEC (Short Time format)

Both Time and Time Tolerance must be expressed in the same form. (i.e. long or short)

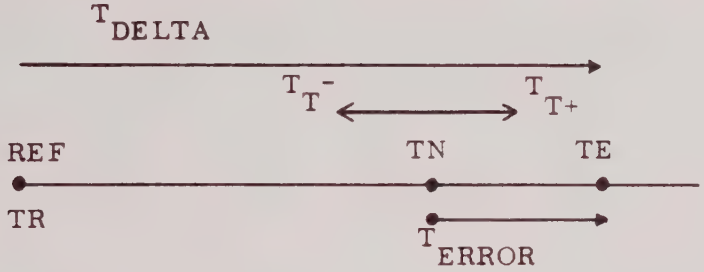
Consider the following example. The reference event occurs at TR and the event occurs at TE.



As long as TE remains in the boundaries of $T_T^- = T_N - T_{TOL}$ and $T_T^+ = T_N + T_{TOL}$, where $T_N = T_{REF}$ + TIME (PROG), the event is considered as occurring within the acceptable time limit. In these cases the event is not printed.

Error Messages

When the time of the event exceeds T_T - or T_T + limits, the event is considered "Out of Time".

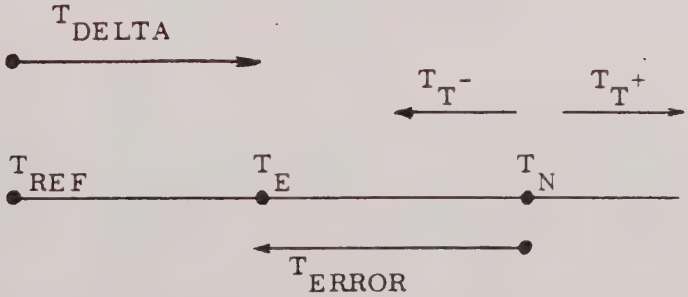


In a case where the T_T + limit is exceeded, a positive tolerance error is generated. The error message is as follows:

+ XX:XX:XX.XXX Tolerance Error [YY:YY:YY.YYY]

where XX:XX:XX.XXX IS THE TOLERANCE ERROR. (T_{ERROR})
and YYY:YYY:YY:YYY is the difference between the event and the reference (T_{DELTA})

Another type of positive error message can also be generated. Whenever the program is not performing any particular function (i.e. diagnostics, user commands, printing events, etc.), it periodically checks to find out if any event time has expired (in the positive direction). Whenever there exists such a case, a TIME EXPIRED ERROR message is generated. The purpose of this message is to inform the user that the event has not occurred at all. Should the event occur some time after the EXPIRE error, the positive tolerance error message is preceded by an asterisk (*).



In a case where the T_T- limit is exceeded, a negative tolerance error is generated. The error message takes the following form:

-XX:XX:XX.XXX Delta Tolerance ERROR (YY:YY:YY.YYY)

where XX:XX:XX.XXX = T_{ERROR} AND YY:YY:YY.YYY = T_{DELTA}

If the reference event does not occur before the event, no tolerance limits can be computed and therefore the event is considered as being "OUT OF TIME". A "NO REFERENCE" error message is generated and the event is printed out. Generally, NO REFERENCE error is an indication that the time data programmed is not a true representation of the cycle being monitored. The basic premise for an event to be referenced to another event is that the reference event must occur before the second. In other words, it is only as a result of the reference that the event occurs.

Many timing errors are due to noisy relays or switches. In the case where an event has been programmed as part of the Out of Time data and this event occurs more times than it is listed in the data, an "UNEXPECTED EVENT" error message is generated. The event is printed out.

3.4.3 Self-Referenced Events

There are many instances where a known cycle of events may occur. However, this cycle is not in any way related to the primary cycle being monitored. In cases such as these, the starting event of the "SECONDARY CYCLE" can be referenced to itself. An Event referenced to itself can never be out of time. (Both Time and Tolerance are forced to zero.) This unique ability permits the monitoring of many independent timing loops simultaneously.

There is a very important restriction on an event that is used as a reference. The reference channel must be entered into the out of time data table prior to any event entry that references it. Any EVENT or REFERENCE may be entered multiple times. Consider the following simplified example.

PROGRAM STEP	EVENT	REFERENCE	TIME
1	1C	1C	Ø
2	2C	1C	1
3	20	2C	2
4	10	1C	3
5	1C	1C	4
6	2C	1C	5
7	20	2C	6
8	3C	1C	7

[Note: Event 1C cannot be the time trigger.]

Note that events 1 closed, 2 closed, 2 opened are repeated. This is permissable. At time ø, event 1C occurs. Since it is referenced to itself, it is not out of time. At time 1, event 2C occurs. It is referenced to 1C so the program will look through the data for the 1C reference that is listed prior to the 2C event. It finds step #1 = 1C and computes out of time tolerances based on that data. Note that the event 1C of data entry #5 is not used. You may think that it is obvious that entry #5 is not used as the reference because it has not occurred yet. That is true in this case but it may not be true in all cases. Consider the following.

PROGRAM STEP	EVENT	REFERENCE	TIME
1	1C	1C	ø
2	2C	1C	3
3	20	1C	4
4	10	1C	1
5	1C	1C	2
6	3C	1C	5
7	30	3C	6
8	4C	1C	7

At time ø, event 1C occurs. It is not out of time because it is its own reference. At time 1, event 10 occurs (step #4). Note that steps #2 and 3 have not occurred yet. This is perfectly acceptable. At time 2, event 1C occurs again. Note that event 1C has occurred twice. At times 3 and 4, events 2C and 20 occur respectively. They are referenced to event 1C. Which event is 1C? The step # 1-1C, because it is the reference listed in the event data table prior to the event data. Likewise, events 3C and 30 use event 1C of step #5 because it is the nearest reference that has occurred that is listed above the event in the table. In this example, events 2C and 20 could have occurred at times 5 and 6 and events 3C and 30 could have occurred at times 3 and 4. The order in which the events were referenced in the table would remain unchanged simply because of the rule that the REFERENCE must be listed prior to the event. Remember, this is an "OUT OF TIME" detection operation and it is independent of SEQUENCE.

To summarize, there are two important aspects of the Out of Time detection: 1) Any event used as a reference must be listed in the event time data tables prior to the Events and 2) the event data need not be entered in order of occurrence (sequence) except where it is required to differentiate multiple occurrences from one another.

3.4.4 Time Trigger

In order to initiate the Out of Time detection, two conditions must be satisfied: 1) The Out of Time is enabled, and 2) A Time Trigger occurs. The Time Trigger is a user definable channel that is activated. Defining the trigger automatically enables the Out of Time operation. The Trigger Event need not be listed in the Out of Time data.

However, in cases where there is a single cycle or multiple cycles related to a single origin (or starting point), the trigger channel should be used as the primary reference channel. The occurrence of the trigger results in a unique function (as opposed to any other event) within the Out of Time program. It establishes an origin with respect to all other occurrences which can be directly or indirectly related. Further, it establishes a criteria of expecting all events to happen. In a sense, it is a form of "RESET" for the timing cycle. Should the time trigger occur before all events of the previous cycle occur or expire, an "INCOMPLETE CYCLE" error message is generated. This error signifies that the cycle has been restarted before the previous cycle was completed. Note: the time trigger, if used as a reference, also must conform to the rules for reference channels. It must be listed prior to any event that references it. For this reason, the time trigger is usually the first entry in the Out of Time data tables. (It doesn't have to be - it just happens to be convenient in the majority of cases.)

3.4.5 Other Out of Time Considerations

Out of Time detection is not a real time operation. In other words, it is not executed at the exact time of occurrence of an event. Therefore, Out of Time does not affect the basic event time resolution. "Out of Time" is calculated just prior to printing event data. The basic decision to be made is whether to print the event or not print the event. All error conditions and messages are secondary. It is important to note that even though an event is not printed, it still occupies event memory. As a result, "Out of Time" is subject to the normal memory overflow criteria. Events occurring more rapidly then the memory can handle will result in a memory overflow condition. Generally, this is not a serious problem because the system event memory is greater than the maximum Out of Time data points (255 max.). A good rule of thumb is that as long as events happen at an average rate greater than an event per 10 millisecond for a no error (no printing) condition, there will be no event memory overflow problems. For rates faster than 1 event/10 millisecond, careful considerations must be given to the event memory capacity.

The Channel Deletion function has a priority over "Out of Time". A delete the return (decimal point in first character of descriptor) will delete the event at the time of printing prior to being processed by "Out of Time". As a result, the event will appear as if it never happened. This is acceptable except if the event is listed in the "Out of Time" data and could be especially troublesome if it is used as a reference by other events. Channel deletion and Automatic deletion fall into the same category. "OUT OF TIME" is not compatible with "OUT OF SEQUENCE". In other words, the "OUT OF SEQUENCE" program cannot be enabled at the same time as "OUT OF TIME".

3.5 TRAP DETECTION

The Software is designed to detect up to 16 separate TRAP conditions. A TRAP is conventionally defined to be a unique configuration of channels and their respective states. Programmed data may consist of any combination of the first 512 system channels. A logical model for a TRAP would be to look at it as if it were an "AND" gate. If the programmed conditions are met, then a TRAP condition is said to exist. There is provision made for considering the "OR" condition of the programmed data to designate a trap. This mode of trap operation is defined by a hardware jumper on the Realtime board. In this the existence of any one of the programmed channel/state pairs will cause a Trap condition. For each trap there exists a 32 character alpha-numeric descriptor which is user programmable. Elapsed time accumulators and transition counters are maintained for TRAPs in the same manner as for channels.

3.5.1 Operator Interface Routines

In addition to TRAP detection, the software provides a full complement of operator interface routines. TRAPS may be programmed and modified from the keyboard. There are commands to display the contents of the TRAPs as well as to summarize the status of all 16 TRAPs. TRAP data and descriptors are saved and maintained in EEROM for saving during power-down. There are also commands to disable TRAP detection and also to re-enable it.

3.5.2 Program Organization

TRAP detection, like event detection, is processed in real time via a CPU interrupt routine. When a channel event interrupt occurs, the Software scans the TRAP data to compare the programmed data against the present state of the inputs. It is important to note that the TRAP detection checks only the present state of the inputs and does not check if individual channels have been deleted. The time of occurrence of a TRAP is the same as the time of occurrence of the event which caused the condition, therefore no time is printed with the trap, but it will be the same as that of the channel which caused it. Trap detection is of a lower priority than the channel transition detection. This means that if the SER is servicing traps, and a channel event occurs, then it will suspend TRAP detection until the input board has been serviced. This means that for rapidly occurring events, there is a possibility that the TRAP message will not be located directly following that of the event which caused it, but could be separated from the event which caused the TRAP transition by another event.

3.6 SNAPSHOT

A "SNAPSHOT" is an instantaneous picture of the state of a group of 64 input channels. The SER uses the second channel of every group of 64 channels as the Snapshot Trigger. (Refer to Table 3-1 for specific channel numbers.) Whenever the second channel of the group of 64 channels changes state from a NORMAL (OPEN*) to an ALARM (CLOSED*) state, all channels in that group will be recorded as having changed state.

3.6.1 Snapshot Set-Up Requirements

Snapshots are part of the 2210-O-110 Trigger Print and Prefault option. This option consists of five switches located on the inner rear panel of the SER Event Processor. In order to use the snapshot trigger characteristic, both the ENABLE/DISABLE switch and the SNAPSHOT switch must be enabled. (NOTE: The ENABLE/DISABLE switch is required for snapshot, triggered print and selected monitoring. It is used as a Master Enable.)

3.6.2 Restrictions and Other Considerations

The SER will not permit the "Out of Sequence" detection to be enabled if the ENABLE/DISABLE switch is enabled. However, should Out of Sequence be enabled at the time the switches are set up for a Snap Shot, Out of Sequence will have priority and Snap Shot will not be enabled regardless of the switch position.

Snap Shots are operable with "Out of Time". However, such an event is likely to generate Out of Time errors. It is not recommended that Snap Shots and Out of Time be enabled at the same time.

The Snap Shot takes priority over deleted channels. If the Snap Shot trigger is deleted (Channel 2), the Snap Shot will still be taken. The deleted channels will not show up in the Snap Shot printout.

Transition counters are incremented during a Snap Shot just as if the event had occurred.

3.7 TRIGGER PRINT AND PREFAULT

Trigger Print and Prefault is used to record and print events upon detection of a "fault". The third through the eighth input channels of every group of 64 channels are used as the triggers for this function. Refer to Table 3-1 for specific channel numbers. All event printing is suppressed as long as these channels are NORMAL (OPEN for channels programmed Normally Open). While printing is suppressed, the SER maintains events in memory while reserving at least 100 levels for post trigger events. Because of the reserved event levels, the SER's memory cannot overflow. It retains the most recent prefault events and discards the oldest data. When any one of the trigger channels goes into the ALARM state, the prefault data and all subsequent post fault data is printed out until all prefault triggers return to their quiescent state (NORMAL).

3.7.1 Trigger Print and Prefault Set-Up

Trigger Print is part of the 2210-O-110 Trigger Print and Prefault option. This option consists of five switches located on the inner rear panel of the SER Event Processor. In order to use the Snapshot trigger characteristic, both the ENABLE/DISABLE switch and the TRIGGER PRINT switch must be enabled. (NOTE: The ENABLE/DISABLE switch is required for snapshot, triggered print and selected monitoring. It is used as a Master Enable.)

3.7.2 Restrictions and Characteristics

Triggered print behaves like Snap Shot with respect to Out of Sequence and Deleted Channels. If the rear panel switches are enabled after the Out of Sequence Detection is enabled, the SER will ignore the switches. The SER will also recognize a trigger even if the channel has been deleted, but the deleted channel will not be printed. It is possible to operate Triggered Print with Out of Time, but special care must be taken and it is not recommended. Unless the initial time trigger has occurred, only Prefault Data which follows the time trigger will be processed. Depending on what portion of Out of Time program is represented, there is a possibility of "INCOMPLETE CYCLE" and "EXPIRED" errors after the prefault triggers return to normal.

3.8 SELECTED MONITORING

Selected Monitoring provides the means to suspend event recording with an externally supplied signal. When the first channel of a group of 64 input channels is in the ALARM state (CLOSED if programmed to be Normally Open) all event recording for those 64 channels is suspended. Refer to Table 3-1 for specific channel numbers. When the channel returns to NORMAL, event monitoring resumes.

3.8.1 Selected Monitoring Set-Up

Selected Monitoring is part of the 2210-O-110 Trigger Print and Prefault option. This option consists of five switches located on the inner rear panel of the SER Event Processor. In order to use the Selected Monitoring function, both the ENABLE/DISABLE switch and the SELECTED MONITOR switch must be enabled. (NOTE: The ENABLE/DISABLE switch is required for snapshot, triggered print and selected monitoring. It is used as a Master Enable.)

3.8.2 Restrictions and Characteristics

Selected Monitoring works precisely the same as Snap Shot and Triggered Print with respect to Out of Sequence and Deleted channels. The Out of Sequence routine does not pay attention to the Selected Monitoring mode. The mode will be enabled or disabled by channel 1 even if the channel is deleted; however, channel 1 will not be printed.

When used with Snap Shot and Triggered Print, selected monitoring takes priority. Selected Monitoring can be used with Out of Time provided it is enabled after the Out of Time program. Error messages may be printed if monitoring is enabled or suspended in the middle of a cycle.

2210-O-110 Trigger Print and Prefault Option
Selection Switch Positions

Table 3-1. Input Channels and Corresponding Trigger Channels

INPUT CHANNELS	SELECTED MONITOR TRIG. +	SNAP SHOT TRIG. +	PREFAULT - TRIGGERED PRINT **
1 - 64	1	2	3 - 8
65 - 128	65	66	67 - 72
129 - 192	129	130	131 - 136
193 - 256	193	194	195 - 200
257 - 320	257	258	259 - 264
321 - 384	321	322	323 - 328
384 - 448	384	385	386 - 391
449 - 512	449	450	451 - 456
513 - 576	513	514	515 - 520
577 - 640	577	578	579 - 584
641 - 704	641	642	643 - 648
705 - 768	705	706	707 - 712
769 - 832	769	770	771 - 776
833 - 896	833	834	835 - 846
897 - 960	897	898	899 - 904
961 - 1024	961	962	963 - 968

+ APPLIES TO ICU ONLY (64 Channels)
** APPLIES TO ENTIRE SYSTEM

3.9 ACCUMULATOR FEATURES

The SER's accumulators are maintained for both channels and TRAPs. They are displayed by setting the Accumulator Display Mode (Via the "SETACC"* command). The elapsed time and transition accumulators will then be printed during every display function. The reoccurrence counter is printed during event printing. The Event Accumulator is enabled by one of the switches provided with the 2210-O-110 option. The description of each accumulator is contained in the following sections.

3.9.1 Elapsed Time. The time accumulators continuously update and maintain the elapsed time of all inputs of the system in the Conduction State. (Elapsed time is accumulated regardless of the selected monitoring mode.) Elapsed time is obtained from a periodic scan of all inputs. Any input in the CLOSED state at the time of the scan will cause its corresponding accumulator to increment. The printout is in the following format:

XXXX:XX:XX

Hours:Minutes:seconds

The data is presented only in the accumulator summary printouts and not in the normal SER event printouts. Elapsed time is also accumulated for "TRAPS".

3.9.2 Transition Counter. The transition counters accumulate the total number of times that each channel has been recorded as changing from one state to the other. The maximum count is 999999. Exceeding this count automatically resets the accumulator to the count of 000000. The transition counters may also be reset by the execution of appropriate system commands.'

The transition counters are only printed during summary mode operation and not at the time of normal sequence data.

The transition counters are incremented for a "snapshot".

The transition counter is incremented even though the channel is not recorded due to either selected monitoring or trigger print modes. The transition counter continues to be incremented even if a channel is "DELETED" from the system.

Transitions for Traps are also available.

*See SETACC command in Section V.

3.9.3 Reoccurrence Counter. This counter maintains the number of times every input channel is represented in any sequence printout. The counter value is printed prior to the channel descriptor. Each reoccurrence accumulator is reset at the end of the sequence. The maximum count of the accumulators is 99 counts. Exceeding the count causes a wrap condition and the counter will be incremented, starting from the value of zero.

The reoccurrence counter is not applicable when the SER is operating in the "Out of Sequence" mode.

3.9.4 Event Accumulator. The event accumulator assigns a sequential count number to every event of a sequence. The counter value is printed prior to any of the normal SER information (i.e., prior to the time of occurrence). The accumulator has a maximum limit of 9999 counts. Exceeding the maximum count automatically resets the accumulator (a wrap condition) to the count of ØØØØ. The line count accumulator can be reset by the execution of the appropriate system commands. The event accumulator is normally suppressed from printing and requires that the 2210-O-110 prefault option be installed in order for printing to occur.

The line counter is incremented for some events that are not printed. For example, "A DELETE THE RETURN TO NORMAL" event is processed by the unit as any other event although it is not printed. In this case, the line counter is incremented.

The line counter is not applicable when the SER is operating in the "OUT OF SEQUENCE" mode.

3.10 CHANNEL DELETION

The Process Analyzer Software provides the means to delete input channels from the system. The deletions are performed in software and are executed entirely through keyboard commands. There are three ways to delete a channel. The "MANUAL" and "AUTO DELETE" functions essentially remove the channel from the system. For these deletion modes, there are commands to delete, restore, and display the channels. The DELETE DISPLAYS will display the accumulator information and the descriptor for each deleted channel. The third deletion mode is a suppression of printing feature - "DELETE THE RETURN."

3.10.1 Manual Deletion

The most basic way to delete a channel is through the use of the manual deletion command. This function removes the channel from the system until it is restored by the operator, or until the Input Board is reset. The boards can be reset via a "POWER ON" or the "RESET INPUT BOARD" command. For every input channel there exists a corresponding deletion mask bit in memory. The status of this bit determines the deletion status of the channel.

When an event interrupt is generated, the delete memory is used to mask out any unwanted (deleted) channel events. When a channel is deleted, no event data is transferred to the stack memory.

3.10.2 Automatic Deletion

The SER user is often able to make a decision as to what is a reasonable number of times that a single channel may occur in a single printing sequence. After a channel has occurred the specified number of times, further transitions on the channel may only obscure more pertinent activity on the other system channels. When the AUTO DELETE feature is used, the SER will delete a channel from the system when a channel exceeds the maximum number of transitions in a single printing sequence. This mode is enabled by programming an AUTO DELETION count. This count is programmed using the "SET DEL XX" command as described in Section 5. The programmed value may not exceed "99", and programming a "00" represents disabling the feature. This count may be thought of as placing an upper limit on the SER's Reoccurrence Counter. There are two modes by which the SER determines the time frame that will specify if a channel's activity is excessive. The mode in use is determined by the status of the SER's Trap #16. If Trap data has been programmed into Trap #16, then one set of criteria will be used; if there is no data programmed, then another set of criteria is used for the automatic channel deletion feature. Making use of the Autodelete mode also limits the maximum count which the Transition Counters may attain. The two most significant digits of the

transitions will always be zero when using this feature, thereby limiting the Transition accumulators to 009999.

MODE 1 - Trap #16 is unprogrammed:

Under normal operating conditions, the SER maintains reoccurrence counters for each of the channels in the system. These counters are printed to facilitate interpreting the event printout. At the end of each print sequence, these counters are reset to 00. If the autodeletion feature is being used, a channel will be deleted when the reoccurrence counter equals the deletion count. If the reoccurrence count does not reach the deletion count in a single print sequence, it will be reset at the end of the printing. Whenever a channel is automatically deleted, it will be restored on the next 8-hour crossings (8am, 4pm, 12 midnight). Autodeleted channels may also be restored to the system upon command.

NOTE: Once the operator has programmed data into Trap #16 and the deletion count is non-zero, then MODE 2 will be the criteria for Auto Deletions.

MODE 2 - Trap #16 is programmed:

An alternate mode of operation for the autodeletion feature allows the user to define a trigger via programming Trap #16. This trigger will have two functions and is defined as the transition of Trap #16 as it goes into the TRAP condition. The first function resets all of the SER's reoccurrence counters, and the second function restores all channels which were previously deleted automatically. It is obvious then that the reoccurrence counter no longer represents the number of times a channel is represented in a print sequence, but rather it represents the number of times that a particular channel has had an event recorded since the last occurrence of the trigger (Trap #16). The user may now define the time frame by which channel activity will be deemed excessive and may provide a signal or program a set of conditions which will restore all automatically deleted channels.

3.10.3 Deletion by Suppressed Printing

The third deletion feature is the "DELETE THE RETURN TO NORMAL or OPEN." In applications where the user is only interested in ALARM conditions or a contact closure, the printing of the normal or open transition can be suppressed. This differs from the other delete functions because only the printing is suppressed. Event data is still transferred to stack memory. To use this feature requires that the descriptor for the channel be programmed with a special character. If the first character of the descriptor is a period (" . "), printing of NORMAL or OPEN transitions for the channel will be suppressed. Lack of sufficient channel descriptor memory, or the descriptor length set to zero, precludes the use of this feature.

3.10.4 Deletion Consideration

In some cases, the unit's operation is altered by deleted channels. TRAPS do not consider the deletion mask bits. Therefore TRAPS will be generated and released regardless of the fact that a channel of the TRAP has been deleted. If a deleted channel is responsible for the generation of any TRAP condition, the TRAP message will be printed and the event will not. This situation will result in not knowing the time of occurrence of the TRAP. Deletion of the snapshot trigger channel (Chan 2) will still result in a snap-shot operation. Deletion of a trigger print trigger channel will still result in the event memory being printed. No indication of which channel triggered the printing will appear because it has been deleted. It is not recommended that any channels programmed into a TRAP or any of the selected monitor triggers be deleted.

Manually or Automatically deleting a channel which is in an Out of Sequence or Out of Time program will prevent the program from being successfully completed. The deleted channel can never have a valid event occur, so an "OVER-TIME" error or an "OUT-OF-SEQUENCE" error will result. If the "DELETE THE RETURN TO OPEN" feature is used, then the event is recognized but printing is suppressed. All of these conditions leave open the possibility that important information will be irretrievably lost. Special care must be taken when using the Delete a Channel features.

3.11 STATUS WORDS

The SER provides the user three ways to define the status words which are printed during event printouts and system displays. The system has two status word pairs between which the user can choose. They are ALARM/NORM and CLOSED/OPEN which will define the state of the input board channels. The SER will assume that the ALARM/NORM nomenclature will be used on the initial powerup but this can be changed by executing an appropriate display command (refer to the display commands in Section V). Once the status word pair has been changed to OPEN/CLOSED, this information will be saved in EEROM so that on all subsequent power-on resets, the unit will start up with the correct word pair.

In the event that the user's requirements are not satisfied by the two status word pairs provided, there is a provision for the words to be user defined. This is done by executing the "STATWDS" command as described in Section V. Once alternate status words have been programmed the SER will use the new nomenclature wherever the words ALARM/NORM would have been used. It is important to note that they will not replace the CLOSED/OPEN word pair.

It is also possible to define status on an individual per channel basis. This is done by programming the words into the channels descriptor message with a "/" between the status words and the descriptor. An example of this format is: RED/GREEN/PROTECTIVE RELAY. In this case the word RED would be substituted wherever ALARM would normally have been printed and GREEN would take the place of NORM. The text following the second "/" would appear as the channel descriptor.

The individual status words are given the highest priority. If individual status words are programmed, they will be used in place of the system status words or the user programmable word pair.

Both system status words and individual channel words are limited to a maximum of eight characters per word.

3.12 DUAL DESCRIPTORS

An alternative to using individual status words to convey specialized messages, is to use the SER's dual descriptor capability. This feature allows the operator to enter two separate descriptors. One is printed with the alarm condition and one is printed with the normal condition. To take advantage of this feature the operator needs only program text in a special format. Both descriptors are entered at the same time, except they are separated by a "/" to delimit them. (e.g. ALARM DESCRIPTOR/NORMAL DESCRIPTOR) In the case of the example the text before the backslash will be printed whenever the ALARM (or equivalent) status word is printed, and the rest of the text will be printed whenever the NORM status word is printed. This feature is compatible with the programmable system status words, but is not compatible with the individually programmable status words.

3.13 STATION IDENTIFIER

The SER provides for a user programmable station identifier. The identifying text may be up to 32 characters long. The characters must be printable ASCII characters (no control characters are permitted). It will be printed during a power on and at the end of each event print sequence. It is also possible to give a station a numeric designation and to have it printed out with each event. If the SER finds two numbers in the first two characters of the identifier, it will use these numbers to overwrite the 2 most significant digits of the event counter. This counter is printed out as a function of a switch on the PREFAULT TRIGGER option board. The text is programmed using the "IDTEXT" command and is saved in the system's permanent EEROM memory. The programmed identifier may also be printed using the "IDPRINT" command.

3.14 BCD REAL TIME INPUTS

The SER Real Time board contains the necessary interface circuitry to allow the user to specify and use an external time base. This time base will most likely take the form of an IRIG B or GOES time code receiver. The only requirement is that the SER is provided with the binary coded decimal signals for time of day from milliseconds through hours. The board is factory preset to attempt to use an external time source, but to use its own precision real time oscillators if this feature is not present. There are several different timekeeping schemes open to the user which are defined via PC slide switches on the Real Time Board. A detailed description of the available switch settings is outlined in Section IV of this manual.

Time and date are normally displayed on the front panel LED display. An "x" preceding time and date is an indication that time is being supplied by the external BCD time source.

3.15 SPECIAL DESCRIPTOR FUNCTIONS

There are several functions which the SER will perform for the user as per special characters programmed into the alphanumeric channel descriptors. The special Delete the Return to Normal character has been defined in section 3.10.3. In addition the user can also designate that Relay #2 be strobed on the 2211-O-401 board whenever a particular channel goes into Alarm, if a ":" is programmed into that channel's first descriptor character. If the second character is also programmed to be a ":", this will prevent the Relay #3 on the same Alarm Contact Board from being strobed.

In addition to the system wide special characters the descriptor for channel 1 has three features which are dependent upon special characters in its descriptor. Taking advantage of these features will preclude the use of the following features on Channel 1 only. Individual Status words, and Alarm board Relay #3 override. There are two characters which affect the front panel keyboard. If the second character is the letter "X", this will permit the operator to execute the "DSPL A" function via the front of the keyboard with the key switch in the operate position. If the 10th character is a ":", then the "RESET" key will not be recognized, but the word "RESET" will have to be typed in character by character. This will prevent tampering or accidental resetting of the machine. The third special character sequence pertains to the hourly time sync pulse. It has been found that the time correction of the SER takes approximately 14mSec to complete. The correction routine takes the time into account, but depending on the location of the equipment and the relay contact provided by the user, a time delay greater or less than 14mSec may be present. The SER program provides a method for the user to designate the amount of delay correction necessary in his system by programming it into the first descriptor legend. The format starts with the third character and is "SYNC MM". The MM is a number from 00 to 99 and will be used as the value by which the SER will correct for the delay. This allows for the centering of the time with respect to the time sync pulse over a range of -14mSec to +85mSec. Following is an example of the use of the first descriptor features.

Channel 1 Descriptor - "ZX SYNC 25 : DESCRIPTOR TEXT"

where: Z = any character ("." for Delete feature, ":" for the special contact)
X = Allow for DSPL A key regardless of the front panel key position.
25 = The value in milliseconds correction for time synchronization via the hourly pulse.
: = Don't recognize the RESET key, but require the Reset command to be typed in from the keyboard.

3.16 FRONT PANEL INDICATORS

The LED display on the 2210-MPT front panel is used to display information concerning system operation at a glance. The indicators are flashed on alternate seconds, with the time and date displayed the remainder of the time. When time is displayed, it is preceded by an "x" if the unit is using an external time base. The other indicators are defined below:

Message	Condition
PRINTER PAPER LOW	Thermal printer paper needs replacing
PRT OFF	Thermal printer has been turned off
RMT OFF*	Remote printer is off
DIAG OFF	Input board diagnostics are disabled
INHIBIT PRINT	Inhibit print mode is enabled
OUT/SEQ ENA	Out of sequence is enabled
OUT/TIME ENA	Out of time is enabled
TRIG	Triggered print is enabled
/SEL	Selected monitoring is enabled
/SNAP	Snapshot mode is enabled

*If the remote was not present during the power-on, this message will be suppressed.

3.17 GATE ANALYSIS SOFTWARE

The Gate Analysis Software (GAS) is an enhanced operating mode of the SER. This mode enables channels and states to be gated together in boolean expressions. Up to 64 gates may have 32 inputs "AND"ed or "OR"ed. The result of the expression is printed in the event printout just after the channel transition which caused the gate output to change.

The hardware required to implement this mode consists of three EEROM chips which are installed in sockets on the Memory Matrix Board. (These chips must be inserted into the U3D, U4D and U5D locations.) This will limit the descriptor memory to 55,296 characters which is a 48-character descriptor for each channel in a 1,024-point

system. (It will accommodate 864 channels at 64 characters each.) In addition to the added hardware, switch S1 on the EEROM Control Board must have all eight sections set to the "on" position. (In the normal setting of this switch, position 3 is open.) If the PROM in location U108 has not been enabled, a software command must be executed. "ENAPROM" must be entered to allow the Gate Analysis Software to be accessed. The "DISPROM" command may be executed to disable this feature.

The operating characteristics of the Gate Analysis Software are as follows. The GAS facilitates recognizing when a unique set of input points is in a unique configuration. The configuration and input points are user programmable and are referred to as GATEs. Each GATE is analagous to a boolean logic gate of an AND or OR type. Each GATE may have up to 32 inputs which may take the form of a system channel; alternately, another GATE output may be used. When the state of a GATE changes because of changes at its inputs, the SER prints out the GATE transition information in its event printout. In addition to the state change information, there is also a 32-character descriptor for each of the 64 programmable gates. The descriptor is printed during the event printout and also during the execution of the GATE status command.

The GAS will run with all other SER operating modes. The GATE transition information is printed out in the normal event printout following the input channel transition which caused the GATE output to change. It is important to note that the GATE information is printed only after the channel information has been processed. If an event printout is aborted by the operator, subsequent GATE transitions will be updated internal to the SER, but the GATE information will not be printed out. The notation used for event printing is as follows:

CASE 1:	GATE xx	GATE DESCRIPTOR TEXT
CASE 2:	GATE xx Not	GATE DESCRIPTOR TEXT

In case 1, a channel transition occurred which caused the programmed GATE conditions to become valid. This represents an asserted GATE output. Case 2 is indicative of the message which is printed after the conditions for a GATE are not longer satisfied. A provision is included to suppress the printing of the return to the "Not" condition in the same way as the "delete the return" to normal works for channels. This is done by programming a special character into the GATE descriptor. If a "." is the first character of the descriptor, the return to "Not" printout is suppressed.

To facilitate data entry, seven operator commands allow for the programming and display of GATE data and descriptors, as follows:

1. PROGGATE XX
2. DSPLGATE XX
3. GATEDESC XX
4. GATESTAT
5. CLRGATE XX
6. DISGATE
7. ENAGATE

These commands are described in Section 5.

SECTION IV

HARDWARE SPECIFICATIONS & TECHNICAL INFORMATION

4.1 HARDWARE

This section of the manual contains descriptions and general discussions and theory of operation of the most popular (and often required) options to the SER mainframe. This material is provided for reference purposes. In cases where specific or more detailed information is required, refer to the particular manual indicated for such data.

EIGHT CHANNEL D.C. INPUT BOARDS (TM-103540 & TM-103815)

2211-O-201 A B C D	8 channel - dual couplers
2211-O-202 A B C D	8 channel - single coupler
2211-O-203 A B C D	8 channel - dual coupler - SWC

EIGHT CHANNEL A.C. INPUT BOARD (TM-103822)

2211-O-208	8 channel - 130 VAC

EIGHT CHANNEL THRESHOLD BOARDS (TM-110000)

2211-O-211 M	20 milliamps
2211-O-211 N	5 amp
2211-O-212 F	5 volts
2211-O-212 G	10 volts
2211-O-212 H	20 volts
2211-O-212 J	130 volts

ALARM CONTACT BOARD (TM-106865)

2211-O-401	8 relays - system status

THIRTY TWO CHANNEL INPUT BOARD (TM-111075)

2211-O-204	32 channel - single return - SWC

COMMUNICATION OPTIONS

2212-O-1111	Dual port adaptor
2212-O-1041	Remote terminal (TTY)
2212-O-1110	Terminal cable
2212-O-1060	Cassette deck - portable
2212-O-1061	Cassette deck - rack mount

POWER SUPPLIES (TM-103582)

2210-O-300	Standard power supply
2210-O-310	Heavy duty power supply
2210-O-310B	48VDC heavy duty power supply
2210-O-320	System power supply
2210-O-320B	48VDC system power supply

BCD REAL TIME BOARD

Standard equipment

4.2 8-CHANNEL INPUT BOARDS

4.2.1 DC INPUT BOARDS

Three basic types of DC Input Boards, each with an 8-channel capacity, are available for use with the system. The input channel characteristics of these boards are listed in table 4-1.

Table 4-1. DC Input Channel Characteristics

Input Board Model No.	Nominal Voltage VDC	Input Impedance Ohm	Input Current Ma	Minimum**Input Voltage VDC	Absolute Maximum Input Voltage VDC ≠
2210-O-201A	24	10K	2.4	20	100
B	48	20K	2.4	40	140
C	90	33K	2.7	75	180
D	125	51K	2.4	105	220
2211-O-202A	24	20K	1.2	20	100
B	48	40K	1.2	40	140
C	90	66K	1.3	75	180
D	125	102K	1.2	105	220
2211-O-203A	24	11K	2.0	20	80
B	48	19K	2.5	40	150
C	90	37K	2.5	75	160
D	125	52K	2.4	105	180

**Minimum activation voltage - typical values are approximately 65% nominal.
≠Exceeding these values may cause permanent damage to the input channel.

4.2.1.1 Input Channel Isolation: 1 KV DC

4.2.1.2 Input Channel Filtering and Debounce Timing

In the -201, -202 and -203 Input Boards, each input signal is optically coupled into a low pass filter. This filter is an analog type which integrates the incoming signal. The typical response of the filter is approximately 0.5 milliseconds. The analog level of the filter output is detected by a threshold comparator which has a significant amount of hysteresis. The signal is further filtered digitally. The digital filter provides for longer debouncing. The time for this filter is set on a system basis to preserve relative time sequences.

4.2.1.3 EMI Filtering (-203 Input Board Only)

The -201 and -202 Input Boards provide sufficient filtering for most applications. For additional protection in noisy environments, the -203 Input Board with built-in EMI filtering, is recommended. The -203 board provides over 70 dB of attenuation for high frequency transients.

4.2.2 EIGHT CHANNEL BOARD THEORY OF OPERATION AND DIAGNOSTICS

The eight channel input boards contain eight individually isolated channels. The input signals are isolated from the internal logic power supply of the SER and from other channels by OPTO-COUPLERS. The detector side of the couplers are filtered by an analog filter to reduce the effects of high frequency transients and contact bouncing. Part of this filter is a squaring circuit which converts the input state into a logic level one or zero. The "cleaned up" signal is then fed into a digital filter. The purpose of this filter is to eliminate multiple recordings of the channel that may be due to contact bouncing. The debounce filter is driven by the system's "debounce clock". Thus all channels are processed in the identical manner. The output of the debounce filter is then compared to the "last known state" of the channel. The last known state is the last recorded state of the channel. When the channel changes state, the EOR gate (refer to figure 4-1.) generates an interrupt and the CPU then records the change of state. During the interrupt period the change of state detector is reset such that any subsequent changes of state will generate an interrupt. There are three basic components which make up the change of state detector. They are 1.) EOR gate 2.) last known state latch and 3.) the change port. Whenever the two inputs of an EOR gate are different the output is a logic level one. One of the inputs to the EOR gate is the signal and the other is the output of the last known state latch. Whenever an interrupt is generated the CPU can find which channel(s) have changed state by reading the change port. If there is a bit set there has been a change. In the case of all eight channel boards, the state latch and the change port are part of the same I.C.. This device is called a Peripheral Interface Adapter (PIA). The PIA also contains two other internal registers that control the operation of the latch, the port and the interrupt.

During most of the time the input board is idle. In fact, when there are no changes of state occurring at the inputs, the CPU has very little to do. DIAGNOSTICS are performed during these periods of inactivity. The CPU can test the operation of the input board circuits. The following is a list of the types of diagnostic tests that are performed along with the associated error messages.

INPUT ? ?	This error message is generated if the diagnostic routine reads the CHANGE PORT and finds any bits set. Under normal conditions the interrupt routines should have found a change of state and reset the detector. If for some reason an interrupt was not generated it is likely that this error would occur. The DIAGNOSTIC routine forces an internal interrupt and the change of state is recorded.

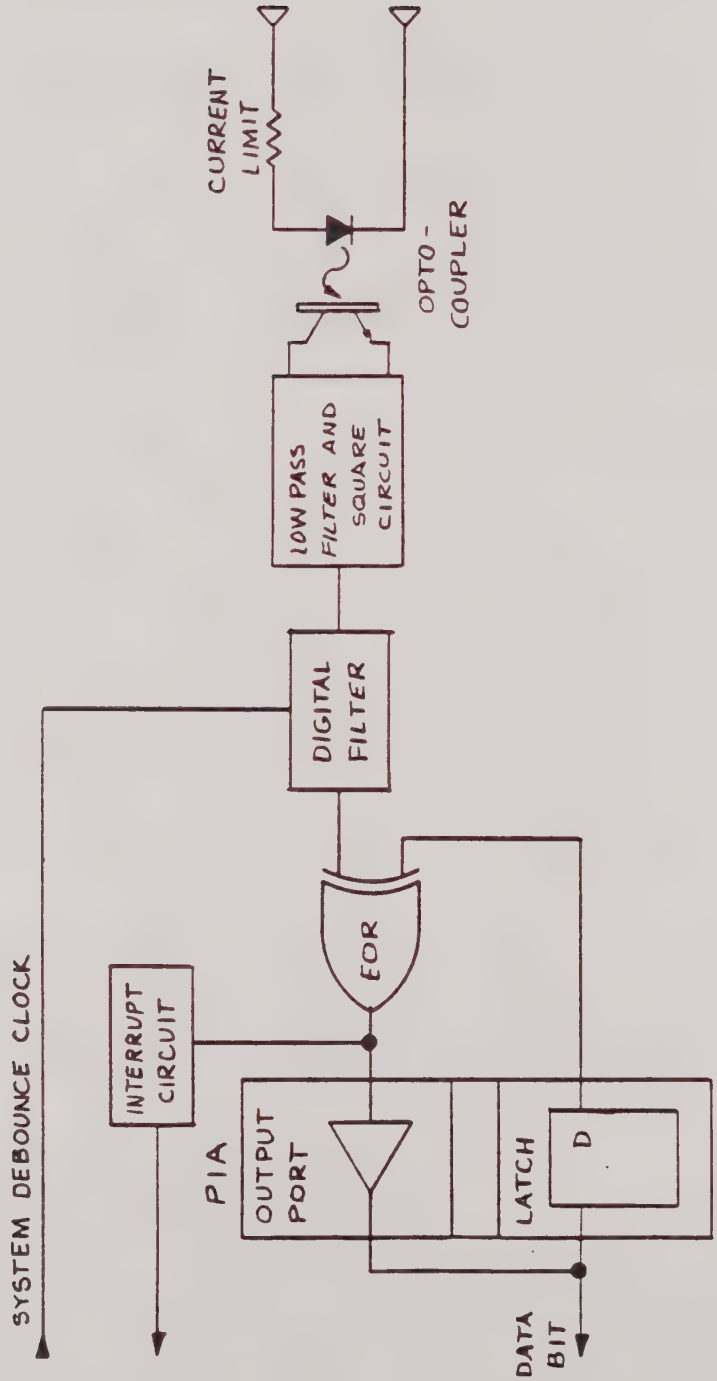


Figure 4-1. Block Diagram: 8 Channel Input Board

P.I.A. ERROR/DUMP	The control registers of the PIA contain specific set up code information. If this code is different for some reason this error is generated. The most frequent occurrence of this error is when an input board is removed from the mainframe.
INPUT ERROR	The diagnostic routine is able to generate a change of state at the input board detector. Since the detector is based on a change, it doesn't make much difference if the channel changes or if the state latch changes. The change detector is set. If for some reason the change port indicates that the bit is not set an input error exists. This error message means that there is something wrong with the change detector (most likely the EOR gate) and will require some maintenance.
DUMP/INPUT ERROR	This error message is a result of the change detector testing except that the interrupt generating circuitry can not be cleared or if the change detector can not be reset. If such a condition existed for long it would seriously impede the operation of the SER and all the other input boards. In this case the SER simply does not recognize the board and removes it from the system operation.
INITIALIZED/RESET	This is not an error message but rather a message indicating that an input board not previously able to be successfully tested has now passed all the required tests. The most common occurrence of this command is when an input board is installed into an active system.

4.2.3 CHANNEL NUMBERING AND DESCRIPTOR MEMORY ALLOCATION

The eight channel input boards are assigned input channel numbers based on their relative position in the ICU mainframes. Numbering is based on the type of input boards being used. When no thirty two channel input boards are used with a particular system, all ICU slots are assigned eight channel increments. Whenever a thirty two channel board is used (even if mixed with eight channel boards) each ICU slot is assigned 32 channels. The board numbers are based on the ICU number and the position within the ICU.

The descriptor memory is assigned to each channel even if the channel is not physically in the particular system. For example, if a system is made of three eight channel boards - boards #1, #3, and #4, the descriptor memory for channels 9-16 (board #2) would have to be provided. Likewise if an eight channel board is used in a thirty two channel board system, 24 channels of the ICU slot are unused and descriptor memory would still have to be provided.

4.2.4 INPUT CHANNEL WIRING

The eight channel input board requires the application of the field contact voltage to consider the channel as being active. The removal of the voltage returns the channel to the inactive state. The SER assumes an active channel is associated with a CLOSED contact. The states of CLOSED and OPENED can be assigned as either ALARM or NORMAL. [Other status words can be used - refer to Special Features: STATUS WORDS]

Examples of typical methods of wiring the eight channel board are shown in figures 4-2, 4-3, and 4-4.

4.2.5 115V AC INPUT BOARD (MODEL 2211-O-208D)

The 2211-O-208D Input Board accepts 115VAC 50/60Hz as its field contact voltage. It is physically and electrically similar to the 2211-O-201D Input Board.

The operational characteristics for the inputs are as follows:

Operate Voltage	100-130 VAC	50/60Hz
Dropout Voltage	30 VAC	50/60Hz
Response Time	1 Cycle	
Sequence Accuracy	1/4 to 1/2 cycle depending on phase of input voltage (for full on to full off).	
Isolation Voltage	650VAC	

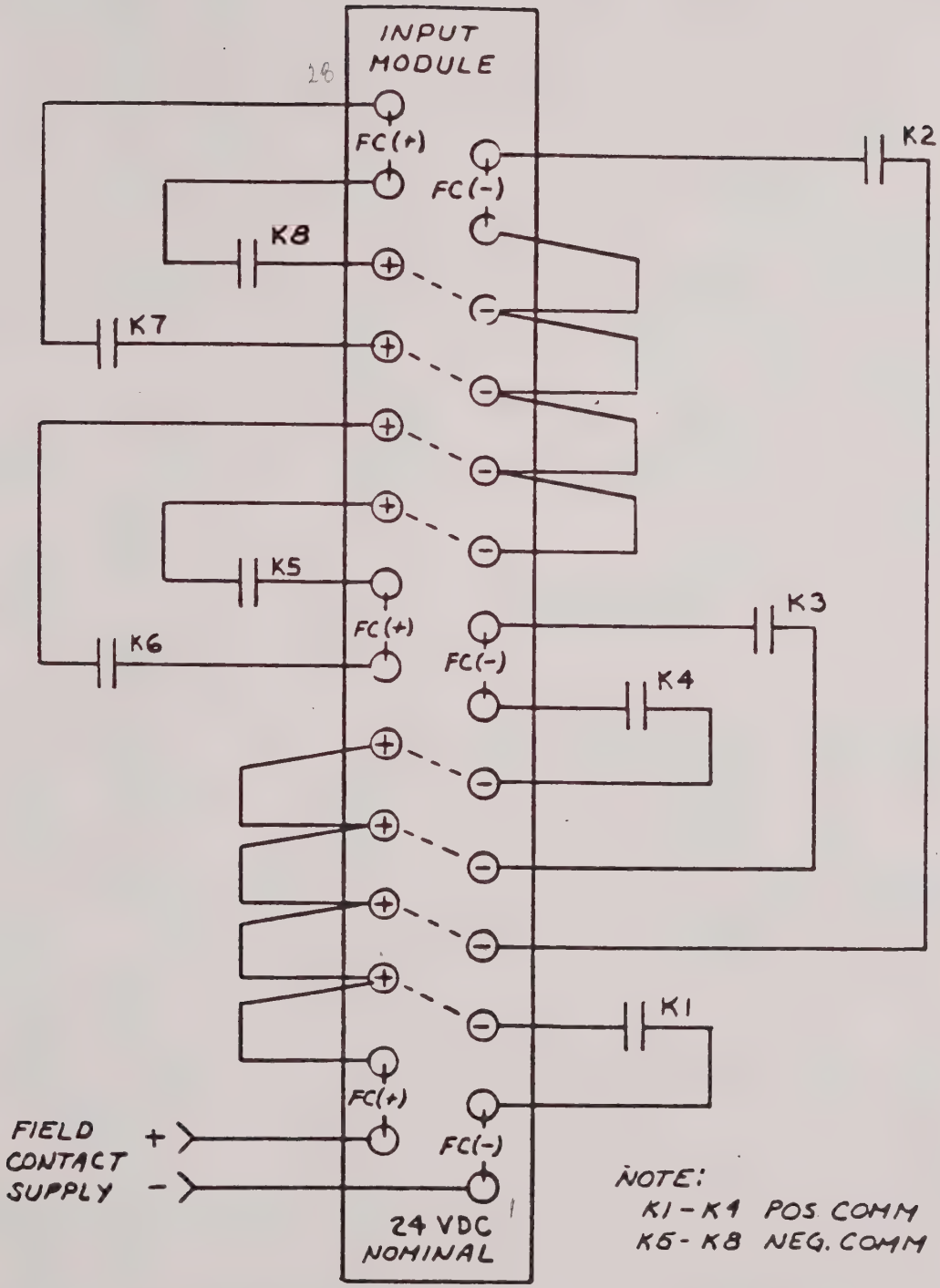


Figure 4-2. Direct Wiring

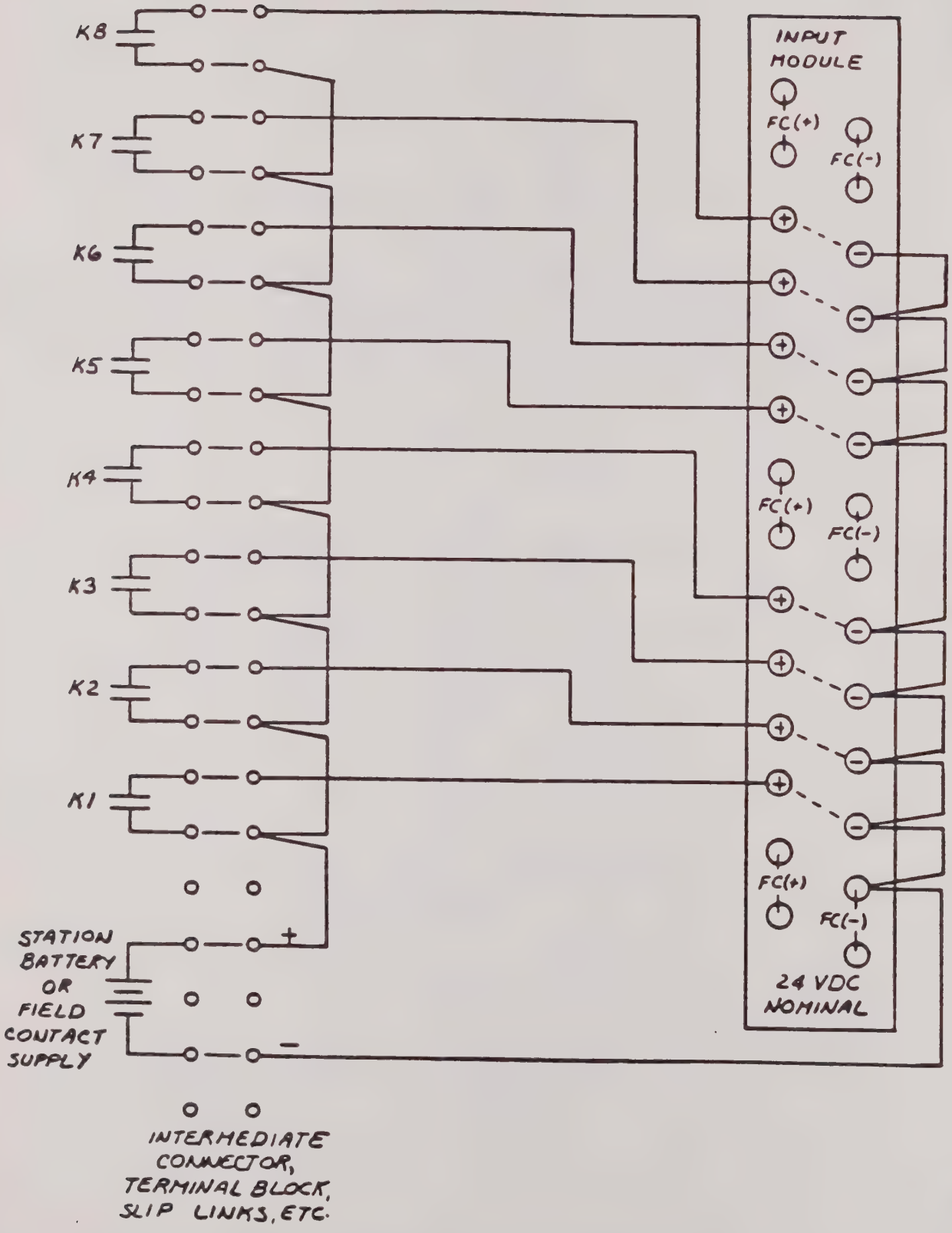


Figure 4-3. Single Wire Connection (Common Negative) and Intermediate Connector

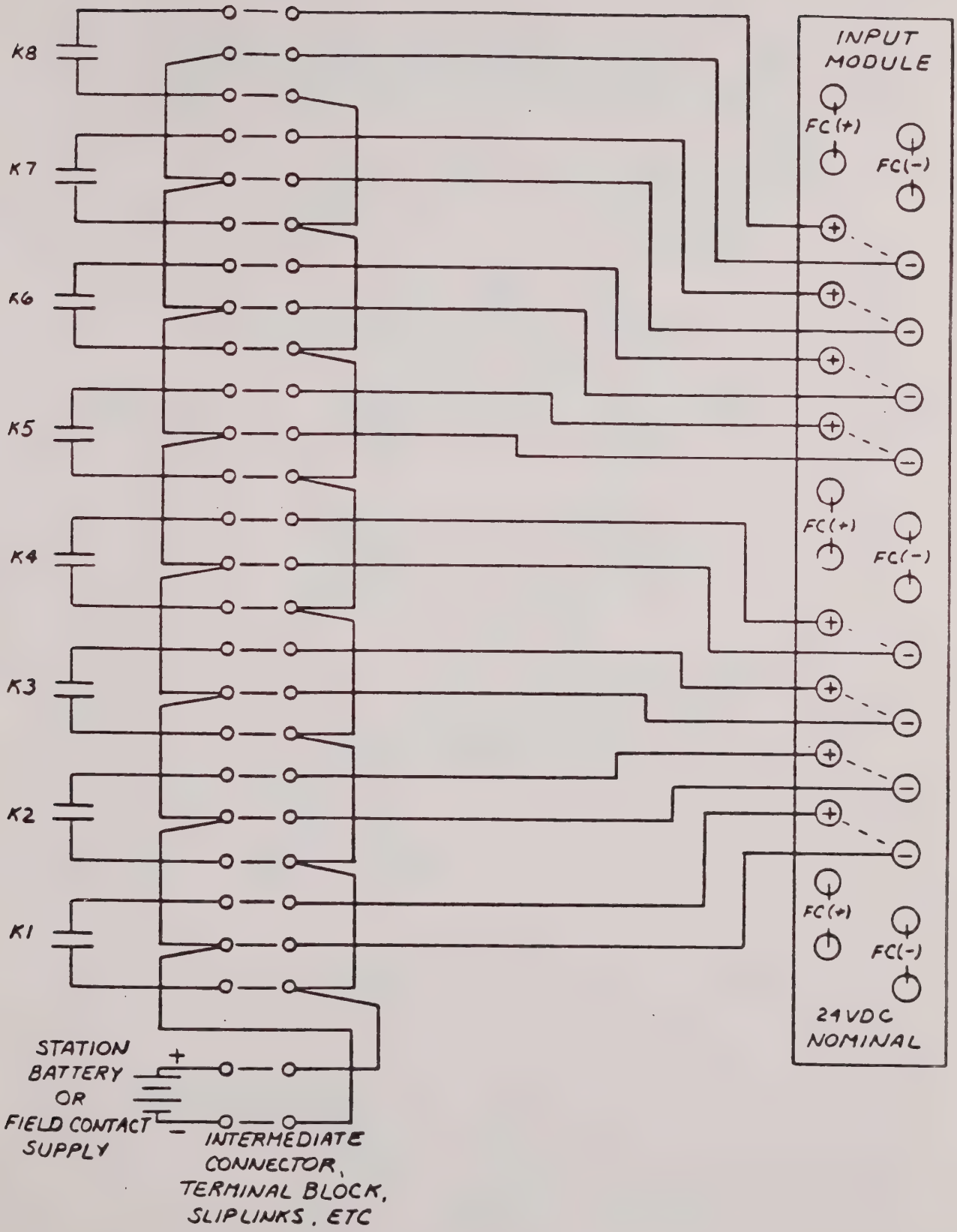


Figure 4-4. Individual Pairs with Intermediate Connector

4.3 4-CHANNEL THRESHOLD (INPUT) BOARDS

The threshold boards convert analog input signals to discrete contact-type form for threshold sensing. An adjustable set point for each analog input is mounted on the input board. Individual input threshold settings are provided by a pair of digital switches. The setting of each input is 0 to 99% of full scale.

Threshold Action:

1) Input less than setting ----- contact open
2) Input greater than setting ----- contact closed

4.3.1 INPUT RANGES

Table 4-2 identifies the ranges for the various threshold board models available.

NOTE

Each input is selectable for either AC (50/60 Hz) or DC operation.

Table 4-2. Threshold Board Ranges

MODEL	RANGE	INPUT IMPEDANCE	MAX COMMON MODE VOLTAGE
2211-O-211M	4-20 mA	10	100
N	1-5 Amp*	.1	250
2211-O-212F	1-5 Volt	1 MEG	500
G	2-10 Volt	1 MEG	500
H	4-20 Volt	1 MEG	500
J	25-130 Volts*	13 MEG	500

*Factory calibrated for AC operation

4.3.2 TECHNICAL CHARACTERISTICS

Table 4-3. Threshold Board Characteristics

Parameter	Characteristic
Accuracy	±1% of setting ±1% of full scale (Add ±0.5% of setting when AC/DC selection is changed after calibration.)
Event Resolution Time	
DC Operation	4 mSec
AC Operation*	32 mSec
No. of channels	4**
Polarity	Must be observed on DC channels
Hysteresis	+0, -5% of threshold (Typ.)

*Any channel selected for AC operation on a board forces all channels to have a 32 mSec response time.

**Since each board occupies one channel position, four channels are unused.

4.3.3. THRESHOLD SETTING PROCEDURE

a. Remove threshold board from the mainframe.

b. Determine the threshold trip point in terms of percent of full scale (F.S.).

EXAMPLE: 1) Given channel A of the 2211-O-212F board (1-5 volts) and the desired threshold is 2.3 volts.

2) The threshold setting is calculated as follows:

$$(2.3/5)\ (100) = \text{Threshold}$$

$$= 46\% \text{ of F.S.}$$

3) Set the channel A threshold switches to the proper value. For this example, set the switch for the least significant digit to 6 and the switch for the most significant digit to 4. Refer to figure 4-5.

NOTE

The threshold switches are small rotary printed circuit board switches that require the use of a small screwdriver. The value of the setting is indicated by an arrow on the switch.

c. Repeat step b for the remaining channels.

d. The channel type (AC or DC) is set by the AC/DC switch. The location of this switch is illustrated in figure 4-5. Access to the switch is obtained through a cutout in the shield. For AC operation the switch is "off" and for DC operation it is "on". The switches are numbered 1-4 and correspond to A-D respectively. Set the switch to the position appropriate for each channel.

e. Reinstall the threshold board in the mainframe.

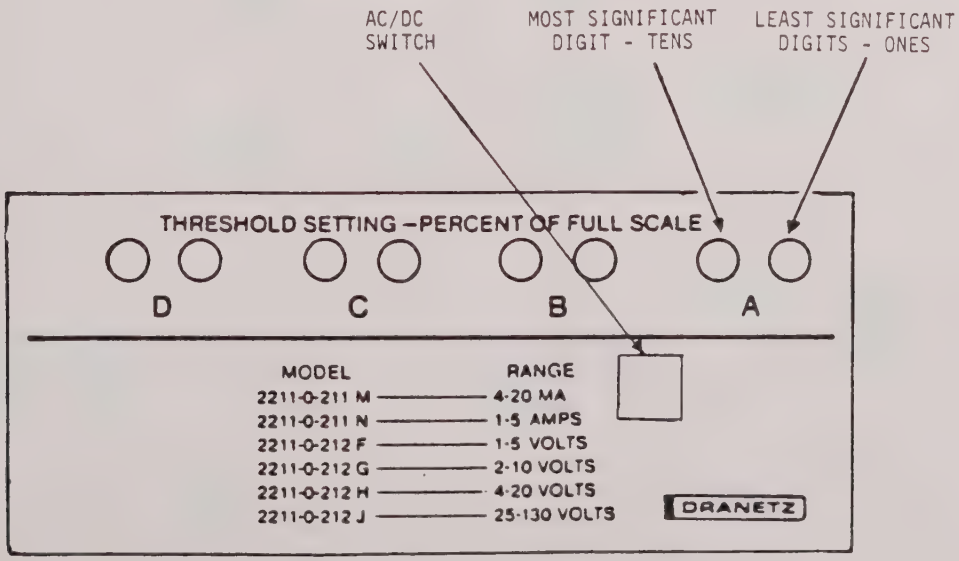


Figure 4-5. Threshold Settings

4.4 ALARM CONTACT RELAY BOARD (MODEL 2211-O-401)

An 8 function alarm contact relay board can be used in place of any Input Board (See fig. 4-6). It allows the user to externally monitor certain events going on within the SER as defined in Table 4-4. The relays are either pulsed on-off or held continuously, depending on definition. The pulsed on-off time is customer selectable and factory set to either 1, 3, or 10 seconds. See Table 4-5 for contact specifications. Other relay definitions are available. Refer to TM-106865 for specific details.

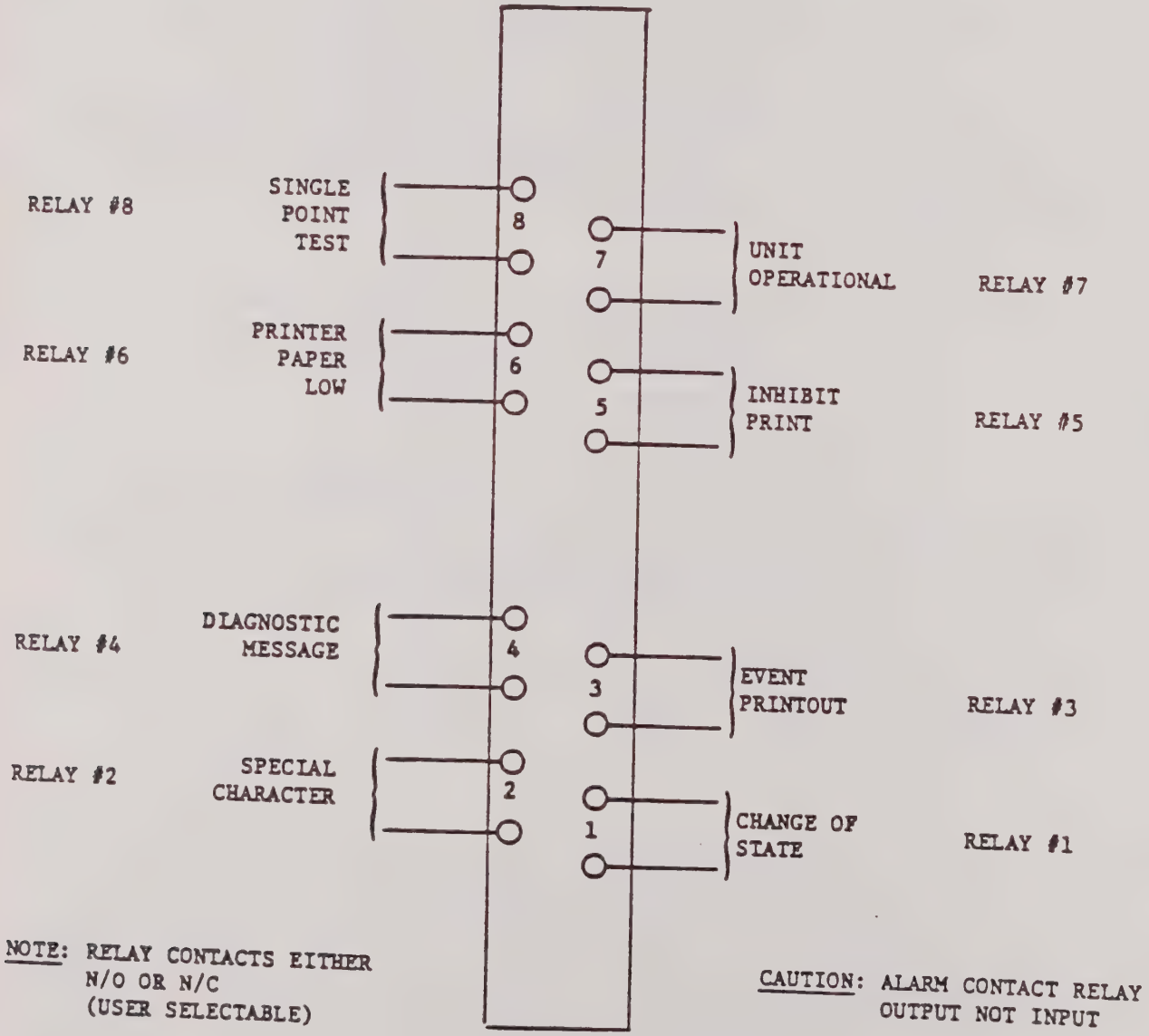


Figure 4-6. Alarm Contact Relay Board Wiring Diagram

Table 4-4 Relay Definitions (2211-O-401)

Relay #	Name	Type	Turn on Time	Special Conditions
1	Change of State	Pulse	Any change of state, activated at time of event (within 1 mSec).	None—all input points will be able to enable relay.
2	Special Character	Pulse	An ALARM EVENT for any input properly programmed with special character for input descriptor, at time of printing event data.	: must be used as first character of input descriptor for that input.
3	Event Printout	Pulse	Any ALARM event at time of event printout, unless special character sequence is used in descriptor memory.	:: will disable the input from activating relay, if used as first two characters of descriptor for that input.
4	Diagnostic Message	Pulse	When any of the five diagnostic messages are printed.	None.
5	Inhibit Print	Continuous	When unit is in inhibit print, the relay will stay on.	None.
6	Printer Paper Low	Continuous	As long as printer paper is low and printer is on, this relay will be on.	None.
7	Unit Operational	Continuous	Proper System Operation will continually enable the relay (i.e., program lock-up, power supply failure, etc.)	None.
8	Single Point Test	Pulse	Once every hour on the half hour, unless system is busy from XX:30:00 to XX:40:00.	Note: If hooked up to input channel, the special character sequence will allow relay #3 not to be activated by this.

Table 4-5. Contact Specifications

Contacts

Rating resistive load	
Max. switching power	60W(D.C.) 100VA(AC)
Max. voltage	220V AC/DC
Max. current	2A
Expected life, min. operations	
Mechanical	10^8
Electrical (2A 30V DC Resistive	2×10^5
Electrical (2A 30V DC Resistive)	10^6
Initial contact pressure	approx. 8.5g (0.3 oz)
Contact bounce	approx. 1.5 mSec.
Contact material	
Movable contact	Gold-clad silver
Stationary contact	Gold-clad silver
Initial contact resistance	
Maximum	50 M
Typical	25 M

Characteristics

Breakdown voltage	
Between open contacts, contact sets	750 Vrms
Between live parts and ground	1,000 Vrms
Between contacts and coil	1,000 Vrms
Initial Insulation resistance	1,000 M at 500 VDC
Ambient pressure	760 mm Hg $\pm$20%
Shock/Vibration resistance	
Deenergized condition	
in contact direction	5G/3G 55 cps.
in perpendicular direction	10G/10G 55 cps.
Energized condition	
in contact direction	20G/20G 55 cps.
in perpendicular direction	20G/20G 55 cps.

4.5 THIRTY TWO CHANNEL INPUT BOARD (2211-01-204)

4.5.1 GENERAL

The thirty two channel input board is used within the SER System 22. This board provides input to output isolation between the monitored channels and the system operational logic. Isolation is achieved by opto couplers and an isolated DC to DC converter (used to power the front end circuitry). All 32 channels input signals are returned through a single return lead and are therefore NOT isolated from each other. The board also contains a digital debounce filter which is synchronized to the system's real time clock. Each channel is detected as changing state at the input board level and is therefore not dependent on either the main CPU or any local scanning CPU. Aside from providing the basic input signal conditioning (isolation debounce and change detection) the input board also contains redundant back up circuitry. The only purpose of this redundant circuitry is to provide an extra magnitude of reliability. The board is also capable of executing an All Points Test that will actively change all input circuitry and verify proper operation.

4.5.2 32 CHANNEL SPECIFICATIONS

Number of Channels	32
Isolation [all channels to earth]	2000 VAC 50/60 Hz. (2800 VDC) 1 minute
Input impedance	1 Meg ohms
Surge capability	3 KV damped oscillatory 1.5 MHz waveform as defined by ANSI C37.90-1974
Filtering (debounce)	Digital debounce filters are provided to eliminate contact bounce. These filters are synchronized to the system time clock. Debounce time is set on a system basis and not a direct function of the input board.
Dimensions	6" x 9" x 1" approximate
Weight	10 oz. approximate
Power requirements (system logic)	5 VDC @ 200 MA (nominal)
Input threshold	The trip threshold is jumper selectable.

	9	8	7	6	5	4	3	2	1
X1	3.8,	7.5,	11,	15,	18,	45,	70,	95,	120
X2	6.6,	12,	20,	26,	33,	80,	124,	170,	215

Connector	The input connector is an in-line socket capable of accepting standard .045 square posts (.156 centers).
Absolute Maximum Applied Voltage	300 VDC

4.5.3 THRESHOLD SETTINGS

The thresholds for the channel are jumper selectable. The threshold is set the same for all 32 channels. (All channels on the same board will have the same threshold.) The threshold value sets the value at which the input board recognizes the "ON" state (logic 1). It is NOT the nominal input voltage of the field contact supply (station battery etc.). The threshold should be selected such that it will guarantee an "ON" state. Typically this value is 70-80% of the field contact supply voltage. In more conservative cases 50% of nominal is recommended. This will not only account for supply fluctuations and variations but also any resistance in the field wiring and relay contacts.

Although there are 18 different threshold variations, only 9 will be normally used. Setting the threshold on the board is done with two jumpers. The first jumper selects one of nine thresholds. The second jumper selects which group of nine threshold values to use (X1 or X2). The X2 range is only used when threshold values are required at very high voltages. Using the X2 range diminishes the input channels capacity to withstand a negative applied voltage. Wherever feasible, the X1 range should be used.

Assume that a nominal station battery of 120 VDC is to be used as the field contact supply. In this case, a threshold of 70 volts would be selected. Jumper J3 would be installed at position 3 and jumper J4 in the X1 position. Refer to figure 4-7 for details on the location of the jumpers and figure 4-8 for board connections.

THRESHOLD VOLTAGE SELECTION

	Jumper X3 position								
	9	8	7	6	5	4	3	2	1
J4=X1	3.8,	7.5,	11,	15,	18,	45,	70,	95,	120
J4=X2	6.6,	12,	20,	26,	33,	80,	124,	170,	215

NOTE: The thresholds are not nominal input voltage

4.5.4 THEORY OF OPERATION (See fig. 4-9)

The 32-channel input board detects the state of each channel by using a comparator for each channel. This method defines the "turn on" and "turn off" points in a very precise way. All channels respond the same way and there are no variations due to opto coupler characteristics. Another advantage of this arrangement is economics. Only one input board is required for a multiple number of voltage applications.

Each input signal enters the input board circuit via an input resistor divider. This divider scales the signal down to within the operating range of the different available REFERENCE voltages. When the scaled input signal is less than the REFERENCE the channel is in the passive or OPEN state. When the scaled input signal is greater than the REFERENCE the channel is in the active or CLOSED state. The OPEN or CLOSED states can be defined as either ALARM or NORMAL by the system software

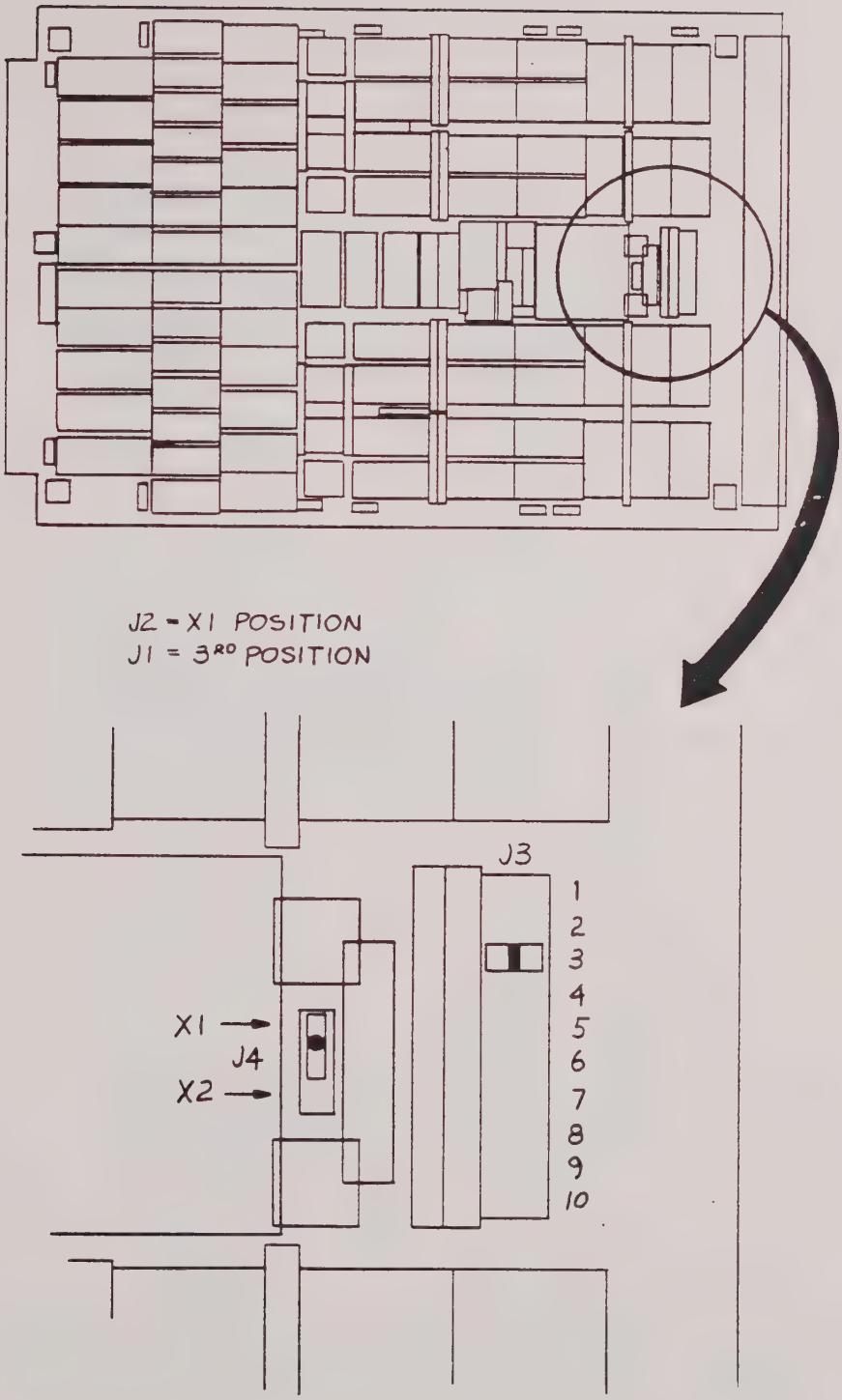


Figure 4-7. 32-Channel Input Board Jumper Locations

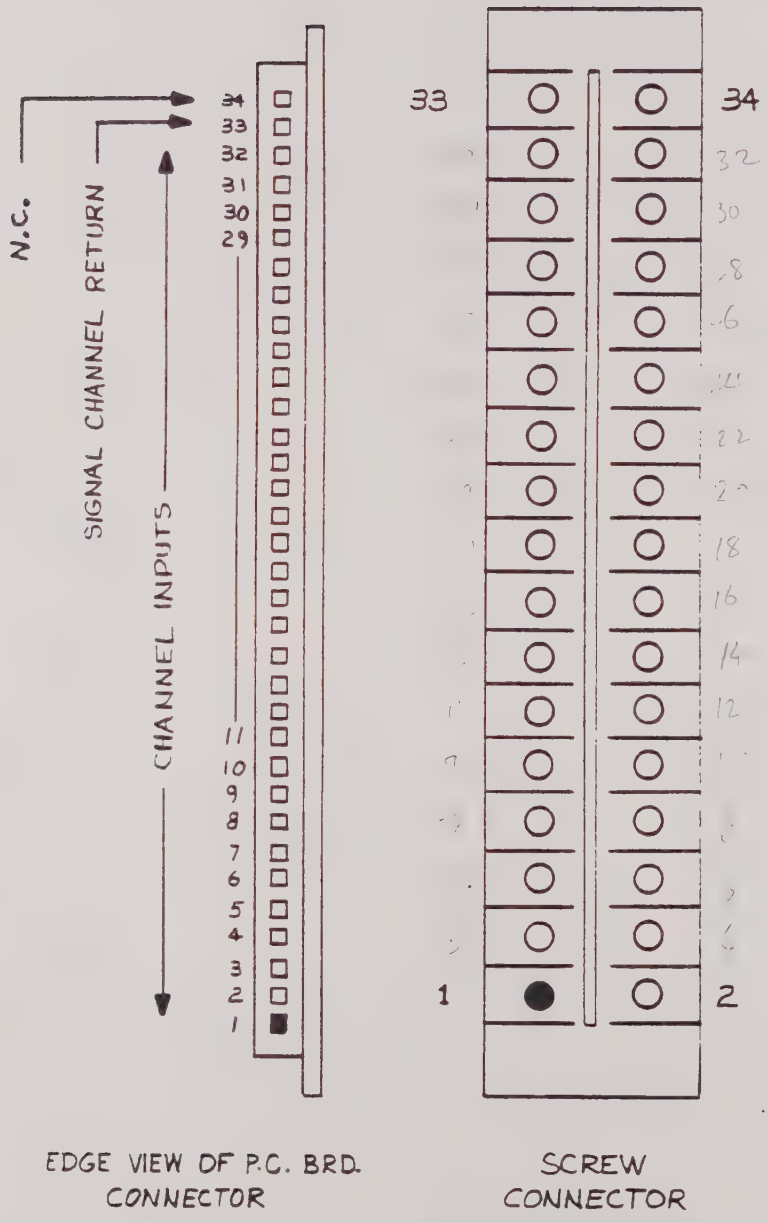


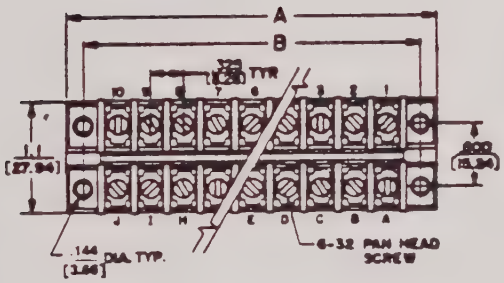
Figure 4-8. 32 Channel Input Board Connections

SCREW CONNECTOR SPECIFICATIONS

SPECIFICATIONS

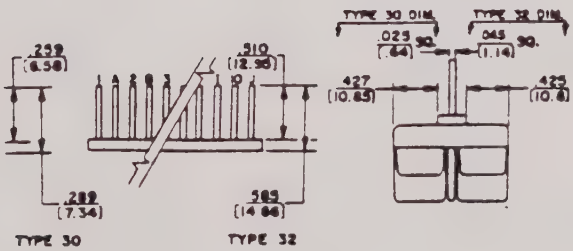
Electrical: 3 A, 150 V

Terminal Strips: Molded from UL rated 94 V-O polyester or fire retardant nylon. Current carrying parts are 70/30 cartridge brass with 200 microinch bright tin coat. Screws are on .325 in. centers in two rows; 6-32 screws accept AWG 14 & smaller wiring, and .250 in. wide wire lugs. Screws bright plated steel.



CENTER SPACING

.156



Total Circuits	Dimensions (Nom.) In. (mm)			
	A	B	C	D
34	6.145 (156 08)	5 85 (148 60)	5.304 (134 72)	273 (6.93)

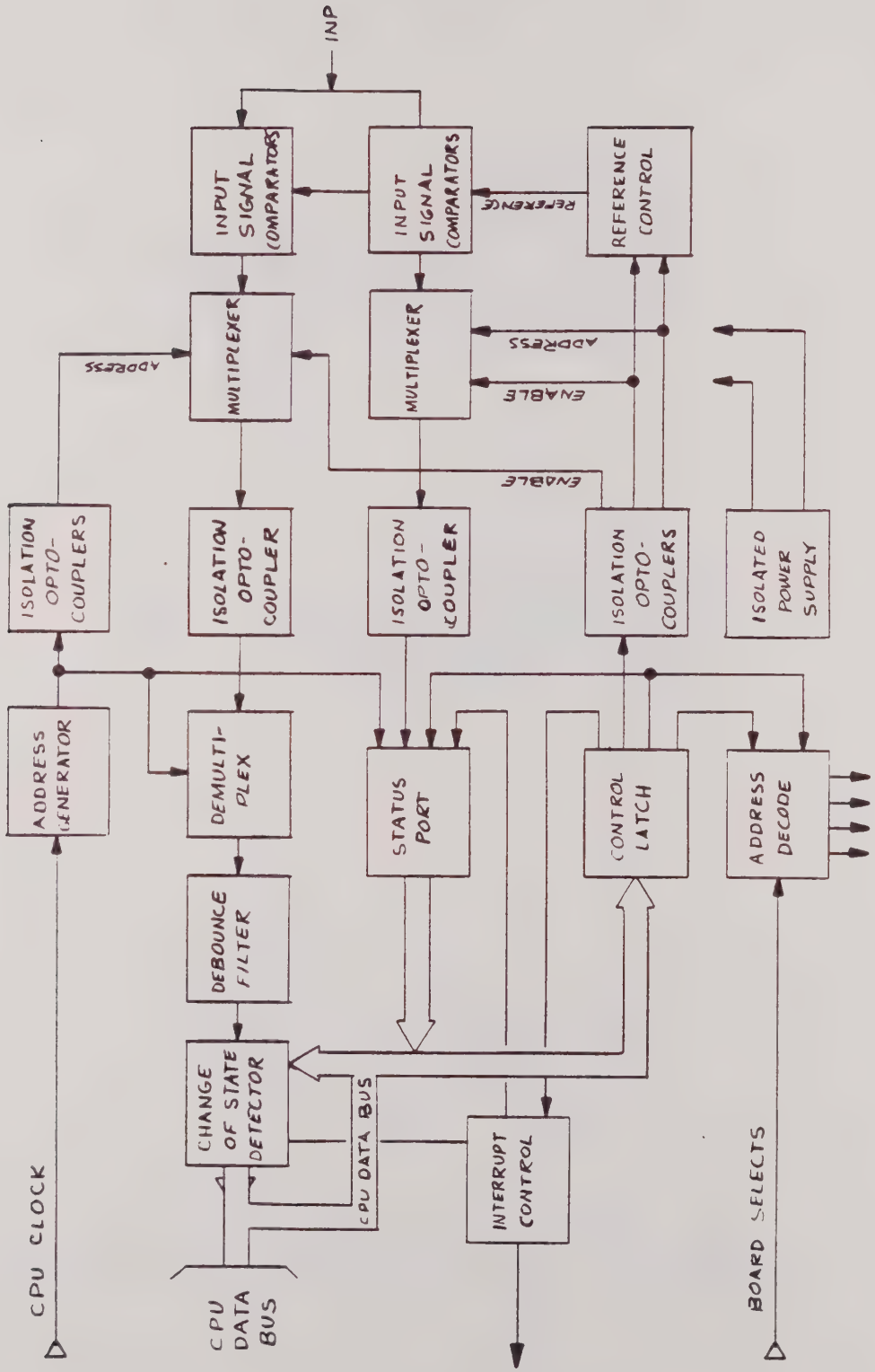


Figure 4-9. 32-Channel Input Board, Block Diagram

(PROGP command). The outputs of the comparators are fed into a multiplexer. The output of the multiplexer is then fed into an opto coupler and de-multiplexed. Actually this multiplexing/demultiplexing is done on a group of eight channels. Therefore four groups of eight channels are being multiplexed, optically coupled and demultiplexed simultaneously. This method of providing isolation, via four optic paths has an economic advantage as opposed to providing 32 channels of opto couplers. This method also uses less printed circuit board surface area, thus permitting all the circuitry for thirty two channels onto a single 6" x 9" board. The demultiplexed signals are then fed into the digital debounce filters. From the debounce filter they go into the change of state detector. The change of state detector compares the present signal to what the main CPU has as the last known state. If there is a difference (because the channel has changed state) an interrupt is generated and the CPU records the change of state.

The thirty two channel input board also contains a redundant circuit. This redundant circuitry is similar to the front end comparators that determine the state of the channel. Redundant comparators are provided which are connected to the scaled input channel signals in the manner as the channel comparators are connected. The output of these comparators are optically coupled directly into a CPU port (via a multiplexer too). This redundant "front end" circuit provides a means for the CPU and its diagnostic routines to check the change of state data path. In addition each of the multiplexers can be controlled by the CPU and checked for minimum performance.

4.5.4.1 All Points Test

One of the important diagnostic features of the SER is its ability to periodically check for the proper operation of the boards from the inputs to the CPU. This is accomplished by the All Points Test which is initiated automatically by the system every day at midnight. The test may also be executed by the "AP TEST" keyboard command.

Under normal circumstances, a channel becomes active because the scaled input signal is greater than the preset reference. During the All Points Test, the reference voltage is forced to a very high value. As a result, no scaled input can be greater than the reference and all channels are inactive. Similarly, the reference is forced to be less than zero (negative with respect to the channel signal return). In this condition, all channels are active even if there is no input signal. Inputs can thus be tested for proper operation by causing the channels to enter a known state.

The All Points Test is a dynamic test. In a static test, all channels would be turned on and off simultaneously. The All Points Test is superior in that it tests each channel individually. When channels are tested one at a time, it most closely simulates operation of the board. If an error is detected, the channel in error is deleted from the system. At the conclusion of the test, one of two messages will be printed. When all channels are operating properly, the unit will print "NO CHANNEL ERRORS". If the test detects an error, the unit will display all of the channels which have failed. The display will follow the format of the other displays (DSPLA or DSPLN) but the channel status will read "DEL/FAIL".

4.5.5 32-CHANNEL BOARD DIAGNOSTICS

The SER contains programs to execute two types of diagnostic tests for the 32-channel board. The primary method of testing a board is through ongoing diagnostic routines. A second method enables the boards to be tested via operator-executable diagnostic commands.

The first method of testing the 32-channel board is similar to that used to test 8-channel boards. The SER is relatively idle when it is not printing messages or retrieving event data. The program makes use of this dead time to test certain system components. Most of the time is spent testing the input boards for errors in order to maintain the integrity of the system. Certain sections of the board must be working properly in order for the 32-channel board to operate at all. The software continuously tests these circuits. Two types of tests are performed. If the software cannot perform the most rudimentary operation (such as correctly addressing the board's control latch), then it prints "BD XX - FAILURE/DUMP" and removes the board from the system. Additional tests check the board's ability to clear a change of state or to generate an interrupt. If any other tested characteristic of the board fails to pass its respective test, the unit prints "BD XX DIAGNOSTIC ERROR". This message alerts the operator that a problem may exist and that the keyboard diagnostic routines should probably be executed to more completely test the board (TESTBD XX and AP TEST). This test will not cause a board to be deleted since, even if something is wrong with the board, valuable information can still be obtained by the test described next.

The 32-channel input board provides two paths for channel data to travel. One path is used for realtime change of state detection; the other provides a means for checking proper operation of the primary path. During the ongoing diagnostics, the SER addresses the front end of the input board directly to compare it to the data it has accumulated from the primary path. If the data does not agree, the SER prints "STATE DISCREPANCY" for a particular channel along with the time the disagreement was detected. This is, in fact, similar to an event printout except that the time resolution is not specified. If the unit detects that the channel is returning to the expected state, it prints "STATE DISCREPANCY RESOLVED".

The CPU is capable of executing a test routine that checks the operation of the thirty two channel input board. This test is performed automatically when the SER first turns on. If there is a failure of any one of the number of tests the board is not initialized into operation. The operator is also capable of executing this test routine by entering the "TESTBD X" system command. There are two major differences when the operator executes this function. The first is that the SER will print an error message for every test that the board fails. The second is that the board is forced to be initialized into the system unless all channels fail. If all channels do not fail, the ones that do will be deleted from the system. The individual tests that are performed are listed in TM-103700 Volume 2 and TM-111075.

4.6 COMMUNICATIONS

4.6.1 DUAL PORT RS232 (MODEL 2212-O-1111)

This option is designed to permit the connection of two terminals (TTY, Modem, CRT, etc.) to the serial communications port of the SER. An internal switch selects one of two possible modes of operation. In Mode 1, the CPU recognizes the "Data Terminal Ready" signal only from the primary terminal. In Mode 2, the CPU recognizes the "Data Terminal Ready" signal from either the primary or auxiliary terminal. The major distinction between these operating modes is that in Mode 1, the terminal designated as primary must function in order to transmit/receive data. Mode 2 requires only that one of the terminals is active and functioning.

A second internal switch determines if the terminal designated as auxiliary is able to transmit data or is a receive only terminal.

4.6.2 REMOTE TERMINAL (MODEL 2212-O-1041)

This Teletype Model 43 Terminal may be used for remote recording and set up. It operates from 117 VAC.

4.6.3 TTY CABLE INTERFACE (MODEL 2212-O-1110)

This 10-foot cable is used to connect the SER and/or the Descriptor Loader Cassette Deck with the Remote Terminal. (See figure 1-2)

4.6.4 DESCRIPTOR LOADER CASSETTE DECK (MODELS 2212-O-1060, -1061)

The Descriptor Loader Cassette Deck enables quick and easy storage of descriptors onto cassette tape from EEROM memory, automatically under system control, or for re-programming the descriptors from information stored on the tape. This allows the user to program the descriptors in a remote location, then take the Descriptor Loader out into the field and program the descriptors quickly on site.

It is important to note that the Data Cassette is powered by 120V AC only. If the AC line should be interrupted and the TTY and SER are operating on battery, data will be lost if the Data Cassette is connected. In addition, if the Teletype paper runs out, its Data Terminal Ready line will go high but the cassette's line will still remain low. This condition will cause the SER to print data even though the TTY is down. To be sure that data is not lost, both of the above conditions should be prevented.

See figure 4-10 for proper interconnections between the Data Cassette and the SER. All switches on the Data Cassette should be properly positioned as defined in Table 4-6.

The RS232 connector on the SER supplies a voltage on pin 25. If the Data Cassette is connected properly, yet fails to operate, check pin 25 of the cassette connector. As shown in Table 4-7, +5V on this pin will turn off its motor. To correct this condition, disconnect the line to this pin in the EIA interface cable.

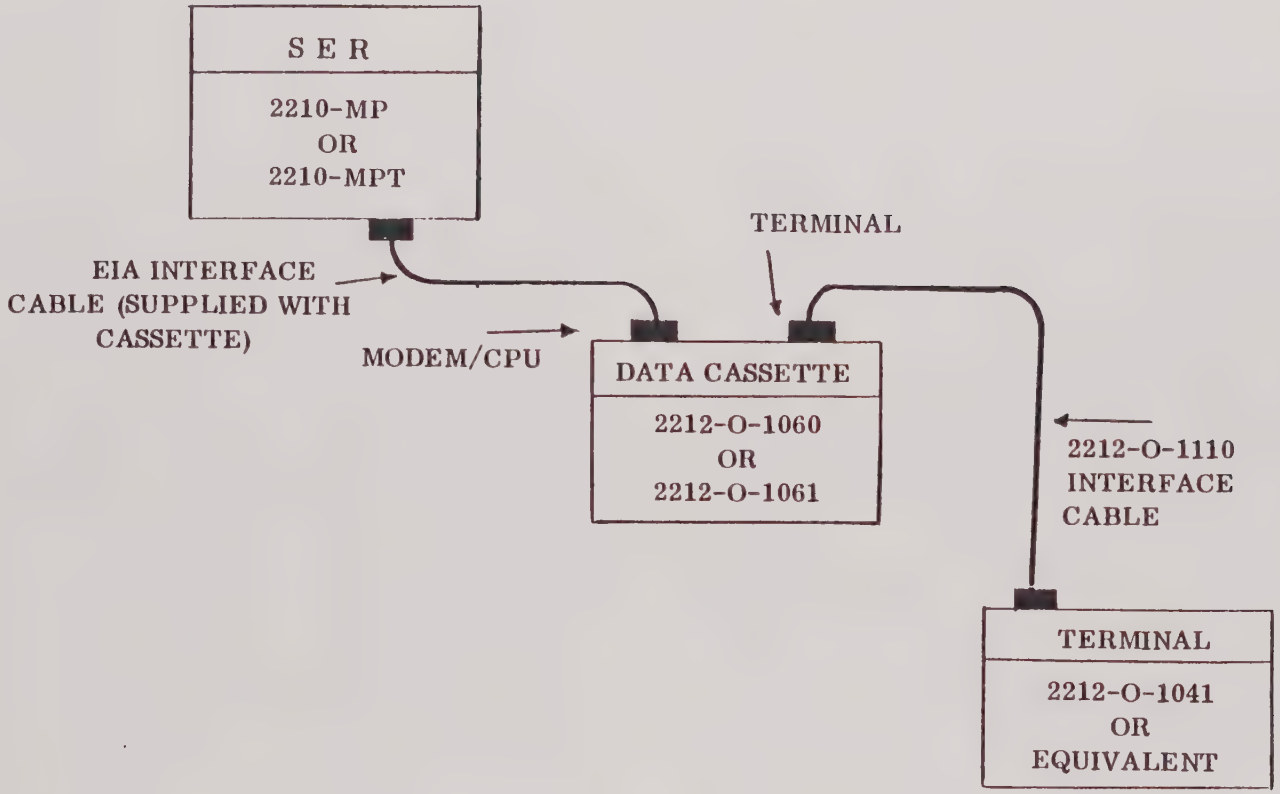


Figure 4-10. RS232 Interconnection Diagram (SER-Tape-Terminal)

Table 4-6. Cassette Switch Functions

Position	Function
1	ON — 300 Baud
2	OFF
3	OFF - XMIT BS DISABLED
4	OFF - HALF DUPLEX
5	OFF - DISABLE DELAY
6	ON - CR LINE MODE
7	OFF - BIN CTRL OFF
8	ON - DELAY ON CR
9	ON - ODD PARITY
10	OFF - PARITY DISABLED

Table 4-7. Cassette Connector Pin Assignments

Pin	Function
1	Protective Ground
2	Transmitted Data (800 Data In)
3	Received Data (800 Data Out)
5	Clear to Send
6	Data Set Ready
7	Signal Ground
8	Data Carrier Detector
20	Data Terminal Ready
16	Rdy/Busy Output (Rdy=OV, Busy=+5V)
25	Start/Stop Input (Start=OV, Stop=+5V)

(16 & 25 are optional features)

4.7 POWER SUPPLIES

4.7.1 GENERAL

The SER has various system power supplies available. These power supplies are used for different system requirements and operating conditions. Table 4-8 defines input specifications. The following summarizes the differences:

2210-O-300	This power supply is used for small systems (less than 256 channels) and operates over a limited range of station battery (115-140 VDC). This supply is also required when the optional Field Contact Supplies are used. Model 2212-O-1021A, 2212-O-1021E, 2212-O-1022A and 2212-O-1022E.
2210-O-310	This power supply is used for expanded systems (greater than 256 channels) and operates from a DC voltage source of 105 - 180 VDC. This supply will also support the optional Field Contact Supplies Model 2212-O-1022A and 2212-O-1022E. NOTE: It is not compatible with Model 2212-O-1021A or Model 2212-O-1021E.
2210-O-310B	This power supply is similar to the 2210-O-310 supply except it will accept a nominal 48 VDC station battery power source. NOTE: This power supply must be used in a 2210B MP/MPT.
2210-O-320 *	This power supply is used to cover a very broad range of station batteries. It will operate from the standard 115/230 VAC line or from a station battery of 100 to 350 VDC. It is capable of supporting a fully expanded system (1024 channels) but is not compatible with any of the Field Contact Supplies (2210-O-1021A/E, -1022A/E).
2210-O-320B *	This power supply is similar to the 2210-O-320 supply except it is used with a nominal 48 VDC station battery. The DC input range is 20 to 60 volts. NOTE: This power supply must be used in a 2210B MP or 2210B MPT.

* These power supplies can not be used in systems that utilize EEROM descriptor memory. Descriptor board P/N 103565, Options 2210-O-102 through 2210-O-128.

Table 4-8. Power Supplies Input Specifications

MODEL	A.C. Input Range Switch 115 / 230	D.C. Input * *
2210-O-300	95-130 VAC / 190-260 VAC	115-170 VDC (95-130 VAC)
2210-O-310	95-130 VAC / 190-260 VAC	105-180 VDC (80-175 VAC)
2210-O-310B	95-130 VAC / 190-260 VAC	40- 53 VDC (30- 37 VAC)
2210-O-320	95-130 VAC / 190-260 VAC	100-350 VDC (90-250 VAC)
2210-O-320B	95-130 VAC / 190-260 VAC	20 - 60 VDC

NOTE: Since the DC input is rectified, it is possible to apply an AC source to the DC input. The range of AC for the station battery input is listed above. If an AC source is used for the station battery input, no AC source should be applied to the AC input.

4.7.2 THEORY OF OPERATION

The power supply in the SER operates in the same manner regardless of the particular model used. Refer to the block diagram of figure 4-11. Each of the inputs are filtered (EMI) and fused prior to being switched by the front panel KEY SWITCH. From the key switch the A.C. is isolated by means of an isolation transformer. The purpose of the transformer is to isolate the line from station battery. The isolation transformer also serves to select the range, 115-230 of the A.C. input. The secondary of the transformer is then rectified by a full wave bridge. Likewise the D.C. is rectified by a bridge. The outputs of each of the bridges are "OR'ed" together. It is this "OR'ed" voltage that is used to power a switching power supply (which is capable of accepting a DC input). The switching power supply converts the high voltage DC into the logic level DC voltages required to run the system (5v, +12/15, -12/15 typ.).

Whenever the nominal AC line voltage is 115 VAC the range switch should be set to 115 position. Likewise whenever the AC voltage is a nominal 230 VAC the range switch should be set to the 230 volt position. This will result in the secondary of the isolation transformer to be a nominal 120 VAC (34 VAC for 2210B MT/MPT) regardless of the input voltage. The transfer to and from the two sources (AC/DC) is based on whichever is the greater at the transfer point (the secondary side of the transformer). Usually the AC source is higher and the DC source is used as the backup. When the station battery is a nominal 120 VDC the SER will operate from the AC source and use station battery as the backup. When the station battery is a nominal 220 VDC the SER will operate from station battery and use the AC source as the secondary supply source.

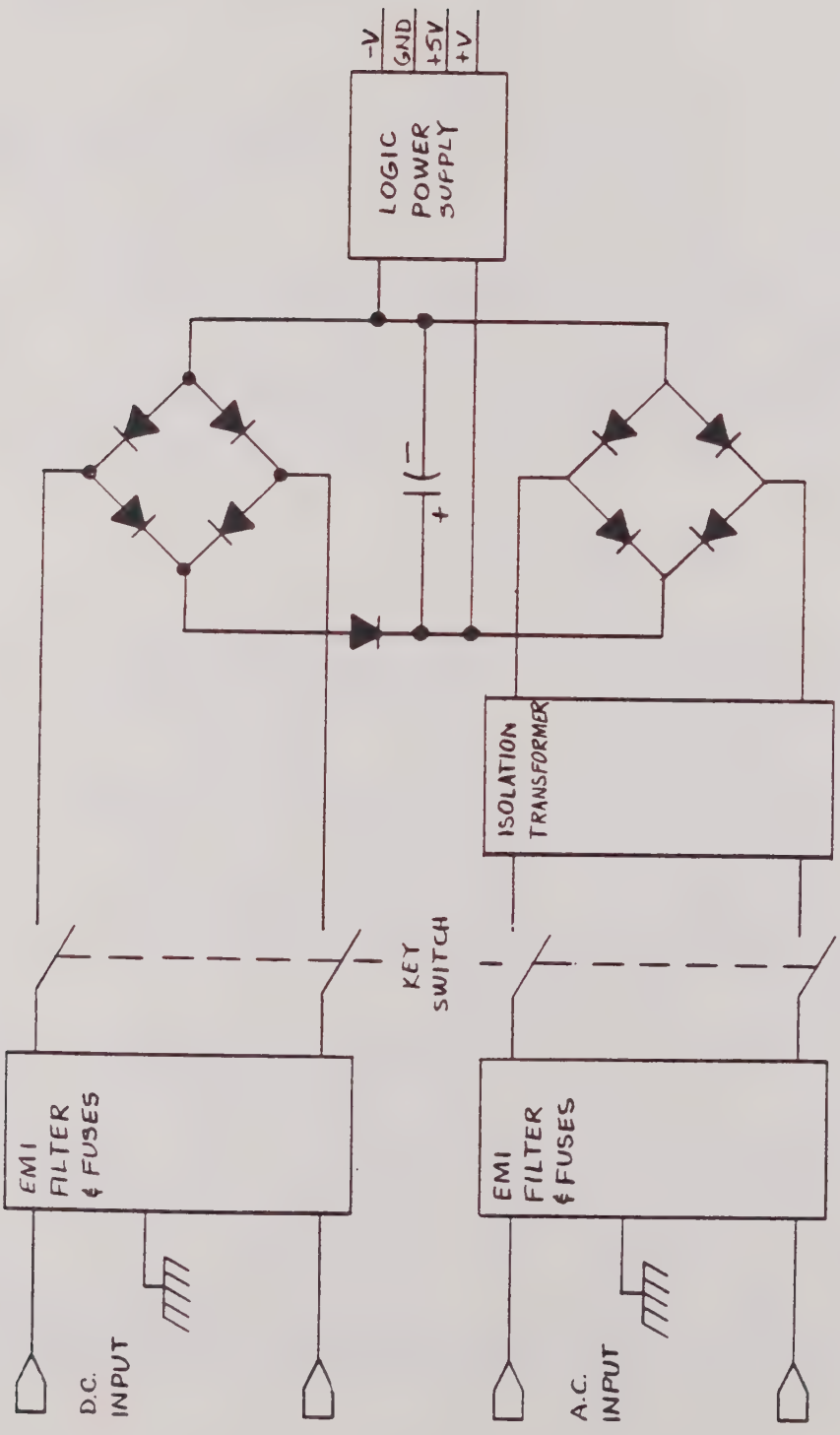


Figure 4-11. Block Diagram: System Power Supply

4.8 BCD REAL TIME

4.8.1 REAL TIME BOARD

The SER's time keeping is done via the real time board located in the mainframe. This board provides the user with the ability to use the SER's oscillator or an external BCD time code. If the appropriate switches are on, the SER will attempt to use the external real time code for event time and all time of day printing. This time input must be in binary coded decimal and provide the time digits from milliseconds through hours. There is no provision on the board to accept day-of-year code. During the initial start up, the operator must set the date but the SER will thereafter save the date in EEROM. This will insure that for system shut downs of less than one day, the unit will start up with the correct date. The BCD inputs are designed to operate with one of the commercially available time code receivers. The time code receiver's signals are then fed through an array of forty optically coupled channels to provide electrical isolation.

4.8.2 REAL TIME BOARD SWITCHES (See fig. 4-12.)

To let the SER mainframe know that this external time base exists, there are two PC mounted slide switches on the real time board. These switches are located in the approximate center of the board with S1 being on the external time input side and S2 on the motherboard side. When these switches are pushed "up" they are off and when they are toward the bottom of the board they are on.

4.8.3 SWITCH DEFINITIONS:

S1: When S1 is in the off state the SER is in its normal operating mode. Time keeping is done by the unit's internal real time clock and it makes no attempt to read the external time ports. However, if the switch is in the on position the SER's time keeping is based on the state of S2.

S2: When S2 is in the off position the SER attempts to use the external BCD time. The decision to use the external time base is not arbitary, but based on ongoing diagnostics. When S2 is in the on position the SER uses the time provided at the BCD inputs regardless of their proper operation or not. This condition effectively defeats any diagnostics which would be done on the external time base.

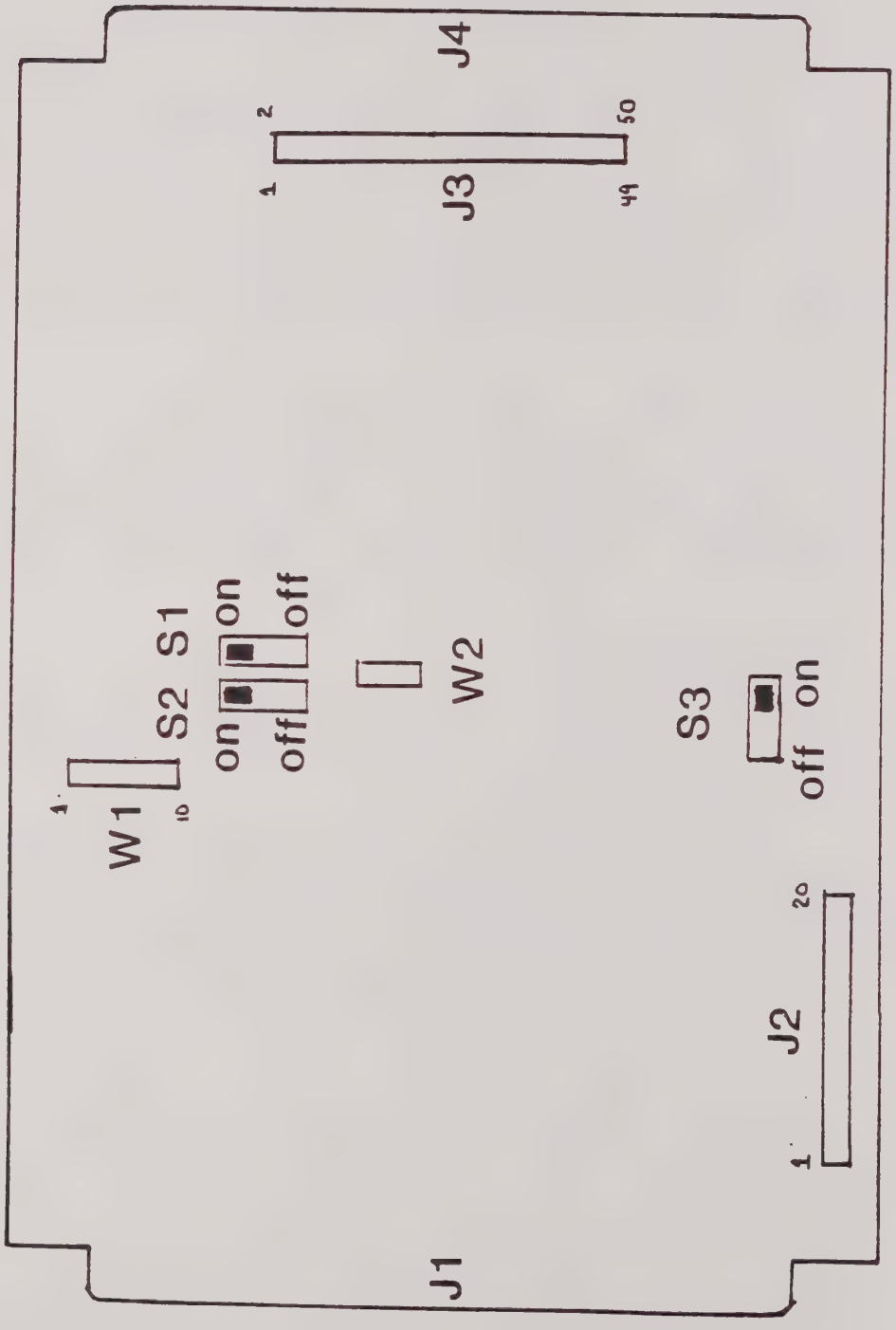


Figure 4-12. Real Time Board Switch Locations

4.8.4 ELECTRICAL SPECIFICATIONS (BCD TIME INPUTS)

Electrical Isolation	-	1.5 k VDC
Input Impedance	-	4.7 k Ohms
Absolute Max. V_{in}	-	30 volts
Minimum Source Voltage (Logic level one)	-	3.9 volts
Mating Connector	-	50 pin D-type Amp #205564-2 or Equiv.

Connector pin definitions:

1	RETURN	18	HOURS 10/2	34	SECONDS	1/8
2		19	HOURS 10/1	35	SECONDS	1/4
3		20	HOURS 1/8	36	SECONDS	1/2
4		21	HOURS 1/4	37	SECONDS	1/1
5		22	HOURS 1/2	38	MILLISEC.	100/8
6		23	HOURS 1/1	39	MILLISEC.	100/4
7		24	MINUTES 10/4	40	MILLISEC.	100/2
8		25	MINUTES 10/2	41	MILLISEC.	100/1
9		26	MINUTES 10/1	42	MILLISEC.	10/8
10		27	MINUTES 1/8	43	MILLISEC.	10/4
11		28	MINUTES 1/4	44	MILLISEC.	10/2
12		29	MINUTES 1/2	45	MILLISEC.	10/1
13		30	MINUTES 1/1	46	MILLISEC.	1/8
14	ERROR b	31	SECONDS 10/4	47	MILLISEC.	1/4
15	ERROR c	32	SECONDS 10/2	48	MILLISEC.	1/2
16		33	SECONDS 10/1	49	MILLISEC.	1/1
17	ERROR d			50	ERROR a	

Table 4-9. Real Time Jumper Settings

REAL TIME INTERRUPT JUMPER (W2)

PIN #	INTERRUPT FREQ.
1	100 Hz
2	10 Hz
3	1 Hz *
4	.1 Hz

DEBOUNCE JUMPER SETTINGS (W1)

PIN #	DEBOUNCE PERIOD
1	2,048 Sec **
2	1,024 Sec **
3	512 mSec **
4	256 mSec **
5	128 mSec
6	64 mSec
7	32 mSec
8	16 mSec
9	8 mSec
10	4 mSec

SETTINGS FOR NORMAL OPERATION
(Refer to figure 4-12.)

S1	OFF
S2	OFF
S3	ON
W1	Pin #10
W2	Pin #3

* The jumper must be in this position for correct operation.
** Not recommended when using 32 channel input boards.

4.8.5 EXTERNAL TIME DIAGNOSTICS

The System 22 SER can obtain the required time-of-day information from one of two sources. Isolated input ports are located on the Real Time board which the unit recognizes as containing BCD time information. Because valid time is necessary for proper and meaningful data aquisition by the SER, certain ongoing diagnostic routines are executed by the software to verify the quality of the BCD time data.

During power-on startup, the SER operates with its own internal time base. It tests the external time for 2 minutes of continuous and valid operation of the BCD inputs. Once the inputs have been checked and validated, the SER changes time sources and prints a message to that effect. The internal clock is also synchronized to the external time base at this time. The SER then uses the external time for all of its time-of-day printing. The 2-minute time frame begins at power-on provided the error "d" input on the Real Time Extender board is logic level 0. On power-on, if this input is a logic 1, the 2-minute frame will not begin until the 1 to 0 transition occurs. This code is provided to allow the user to connect an appropriate code from the BCD time code generator which is a logic 0 when the time code outputs are valid. (Switches located on the Real Time Extender board enable the error code inputs to be disabled if none are available.) Execution of the diagnostics continues; if any errors are found, action is taken.

Two distinct types of time diagnostics are performed and each causes different responses. If an error is found in the low-order time digits (milliseconds-one through seconds-ten), the SER discontinues the use of the external time inputs and reverts to its own internal clock. Catastrophic errors to the time code will be discovered almost immediately since the unit monitors the milliseconds-one digit for continuous transitions. Single bit errors (opens or shorts on a bit) require the time codes to enter a particular state such that a transition on a bit may be expected to "ripple" to higher order bits (e.g. 1.999 sec + .001 sec = 2.000 sec). These errors will be detected, but some delay may occur before the state exists which will make detection of the error possible. At all half-hour crossings following an error, the unit will begin the diagnostic procedure again. If the external time base is still functioning properly at the next hour crossing, the unit will reenable the external time. When the BCD time is valid again, the SER will reenable its use and print a message "EXTERNAL TIME ENABLED".

The second type of time diagnostic test which the unit performs compares the external time to the SER's own internal time clock. An error will be detected if the SER's internal clock and the BCD external time show more than a 1-minute difference. If an error is detected in the high-order time digits, the SER will print an error message, but the use of the external time will NOT be interrupted.

In addition to the error messages which are printed whenever the time diagnostic routines find an error, there are two other occurrences when error information is printed. The error code logic inputs on the Real Time Extender board are saved with each event time on the SER's event stack. When the event time is printed, the printout records the most significant active error code at the time of the event. This is displayed as a letter immediately following the event time. The "d" error is the most significant, followed by c, b, and a. In addition to this, at the end of each event printout, the SER executes a "TIME" command. This command prints out the time and date. It also prints out one of two possible messages if the external time is in use. (No additional messages are printed if the unit is using internal time.) The message "EXTERNAL" signifies that the SER is operating on external time. "X-EXTERNAL" means that the SER is using the BCD time base, but that the diagnostic routines have found an error that day. It is important to note that these messages reflect the status of the external time at that moment and do not necessarily correspond to the status of the event time. The only condition possible in which the status may be different occurs if the events took place with the unit in INHIBIT PRINT.

At the end of each day, the SER corrects its own internal clock to match the BCD inputs, provided there were no errors of either type detected during the previous 24 hours. This is done to ensure that in the event of a fatal external time error, the time skew incurred from switching to the internal time clock will be minimized. At the day crossing there is also a message printed to relate the status of the time source. By setting the switches on the Real Time board, the message may be "INTERNAL TIME ALWAYS", "EXTERNAL TIME ALWAYS", "TIME DIAG/INTERNAL", or "TIME DIAG/EXTERNAL". The first two messages mean the SER is using the associated time source without regard to proper operation. The last two messages inform the operator that the SER is performing diagnostic routines on the external time source, and also identifies the source presently being used.

EXAMPLES:

In a hypothetical substation, a utility has a DRANETZ System 22 SER which is connected to a True Time Model 468-DC Satellite Synchronized Clock.* The following are a few examples of SER operation with respect to time keeping.

1. In this substation, the 468-DC is under power and locked on to the GOES satellite. When power is applied to the SER, it turns on using its own time clock. Approximately 2-1/2 minutes into the SER's operation, it switches to the BCD time source and sets its own clock to the time on the BCD ports.

*Kinemetrics True Time Div. 3243 Santa Rosa, CA. 95401

2. The SER and 468-DC are turned on simultaneously. The SER uses its own clock. Fifteen minutes into the SER's operation, the 468-DC has locked onto the satellite and satisfied its own verification criteria. At this time, the error codes output by the receiver are deasserted. Two minutes after this event, the SER switches to the BCD time source and sets its internal clock to match the BCD time.

3. After several days of normal operation and internal time correction, an operator in this same substation accidentally disconnects the SER from the receiver. The SER immediately defaults to its own internal time clock, prints a message, and strobes the diagnostic relay on the -401 Alarm Contact board. If the operator reestablishes the connection, the BCD time will be used again after both a half-hour and hour have been crossed. At midnight, the summary message will show that the unit is using the external time base, but the internal time will not be corrected until the following day.

4. An alternative error to example 3 would be one in which only a wire on the "hours-one" bit broke off the connector. If this should occur, the SER will find the external time to be in error and will print a message and strobe the -401 relay. The message which is printed contains the Delta time which is the time difference between the internal and external sources, as well as the internal time clock's time. The time difference may be helpful in determining which bit is in error. However, the unit will not default to its internal time. In this hypothetical case, all times displayed will now be even since there is no drive to the hours-one bit. This is not deemed a catastrophic occurrence since often related events of interest are separated by short times (in the order of seconds or less), and high order time information may often be obtained from other recording devices which recorded the same fault. At the day crossing, the time will again be corrected only after the bit in error has resumed normal operation for a 24-hour period.

4.8.6 REAL TIME EXTENDER BOARD (111087)

The real time board interfaces with the external time code generator and the hourly time sync pulse via the REAL TIME EXTENDER board. This board contains a 50 pin D type connector with which the SER may interface with any BCD time code. The board contains a 4 line DIP rocker switch. This switch is used to enable the use of error codes which may be available to the user from his BCD time source. Switches 1-4 pertain to errors a-d respectively. When error signals are active, the letter designating the most significant active error code in existence at the time of the event will be printed following the time data. Switch 4 carries the most significant error (d) and so on in descending order.

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* Complete loss of input signal

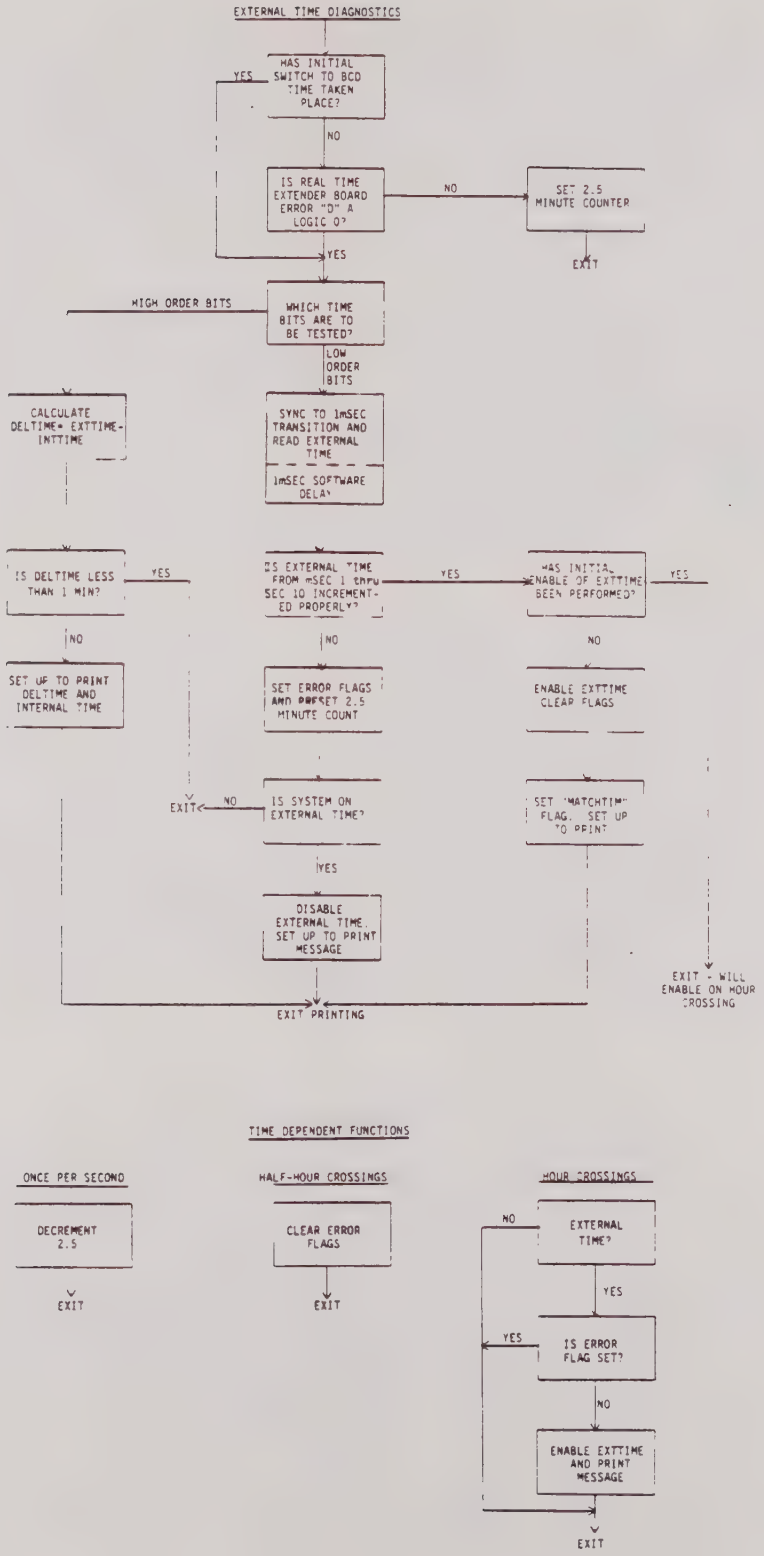

Figure 4-13. Time Diagnostic Flowchart

4.8.7 REAL TIME BOARD HEADER POSTS

When the Real Time Board is put into an MP unit, the connections to the front panel push buttons are made through post assembly J2. J2 is located at the bottom of the board and near the motherboard edge card connector. These pins are pulled to a logic level zero when the switch is depressed. The SER's CPU then interprets the switch commands and executes the appropriate function. Some of these pins are also used when the board is in an MPT. The SER uses some of the jumper pins to allow the user to specify a configuration of the unit's operation as it would best suit the particular SER application. These pins are denoted in the table by a "*" and a description of their functions follows.

PIN DEFINITIONS

PIN #		SWITCH COMMAND
1		Logic Ground
2	*	RMT Default
3		SKIP (control C)
4		MEMORY
5	*	ZMSMS WINDOW
6	*	DEFEAT EVENT PRIORITY
7		MAPSYST
8		DSPL
9	*	TRAP LOGICAL "OR"
10		MP/MPT
11		TIME
12		DSPLA
13		DSPLN
14		RESETIN
15		SER HOURLY PULSE
16		INH/ENA PRT
17		RESET
18		N/C
19		SWITCH POSITION
20		RMT ON/OFF

4.8.8 SPECIAL PIN DEFINITIONS

In order to take advantage of the special user definable features, there must be some jumpers added to the real time board. These jumpers must connect the pin in question to logic ground. These special pins are denoted by the "*" in the above table.

4.8.8.1 RMT Default

This pin allows the user to define the behavior of the SER in the event that the remote device is not functioning and the front panel thermal printer is off. When the pin is left as is (not jumpered to ground), the SER will attempt to send characters to the remote indefinitely. This mode of operation may be desirable in the event the SER is connected to a modem. The peripheral may be busy at times when the SER wishes to send data, but will invariably become available after a short delay. In this case the user would not want the SER to default to the thermal printer immediately, but would want it to wait until the RS232 port is no longer busy. In the event that the peripheral device is actually down, it is still possible to gain control of the SER through the front panel keyboard by entering a "SKIP" character. After the "SKIP" character is entered the SER will default to the thermal printer in the same manner as described below.

When the pin is jumpered to ground the SER will immediately turn the thermal printer on if it determines that the remote device has failed. An appropriate message will be printed, and the SER will continue with whatever it was printing. When it is no longer busy the SER will print messages signifying that the Remote has been turned off and the Printer has been turned on.

4.8.8.2 ZMSMS Window

This pin allows the user to instruct the SER to be more discriminating as to its time correction due to a once per hour pulse. Under normal conditions (when the pin is NOT jumpered to ground), the SER will correct its own internal time clock to the nearest hour when the Zero Time Sync pulse occurs. However, in some applications this criterion is considered too broad and a plus or minus 5 minute window is more appropriate. In this case if the pulse occurs and the SER's clock is not within 5 minutes of an hour crossing, then no correction will take place.

4.8.8.3 Defeat Event Priority

Under normal conditions the SER gives event printouts priority over all other functions of the machine. This means that if the operator is executing a command (eg. DSPL) and an event happens, the SER will terminate the command printing and process the event data. This insures that events will be printed as soon as they occur. This feature is not always desirable however. In some cases the events which the SER is monitoring are not so pressing that immediate analysis of the event printout will be necessary. In a case such as this, the pin may be grounded, and the operator will not be susceptible to the annoyance of having his SER usage interrupted by event printouts.

4.8.8.4 Trap Logical OR

During normal operation, the TRAP condition is defined as a logical "AND"ing of the specified channels and their states. When this pin is jumpered to ground, the Boolean algebra used to determine a TRAP condition is changed such that an "OR"ing of the programmed channels and states is recognized as causing a TRAP.

4.8.8.5 SER Hourly Pulse

In application in which more than one SER is operating in a particular area, it may be necessary to synchronize the time clocks. By grounding pin 15 on the Real Time Board header, a method of synchronization may be realized. This pin will redefine the single point test relay contact on the Alarm Contact Board. Instead of a contact closure on the half hour, this pin will cause the contact closure to occur precisely at the hour crossings. The closure could then be used as the input time sync pulse for the other SER's.

NOTE

This function is applicable only to systems which derive time from the internal source.

SECTION 5

SER SYSTEM COMMANDS

Table 5-1 SER System Commands

Ref	Keyboard Entry Command	Function
1	TIME	Prints time and date on thermal printer and teletype.
2	INT TIME	Initializes time to 00:00:00.000
3	SET TIME XX:XX:XX:XXX	Programs internal time clock to HH:MM:SS.MSEC
4	SET DATE XX/XX/XX	Sets date MM/DD/YY.
5	ZMSMS	Resets minutes, seconds and milliseconds to zero.
6	ZRTM	Causes system to reprint last ZMSMS printout.
7	EXTTIME	Enables use of external time via keyboard.
8	XTAL	Forces SER to use own crystal oscillator as time base.
9	MATCHTIM	Matches SER's internal time check to external time base.
10	DAY	Daily function.
11	EIGHTHR	Eight hour function.
12	HOUR	Hour function.
13	HALFHR	Half hour function.
14	INTIME	Print internal time.
15	EXTIME	Print external time.
15A	DELTIME	Calculate and display internal/external time difference.
15B	* TESTBCD	Test routine for BCD inputs.
16	DSPL	Displays summary of all SER system inputs.
17	DSPL XX	Same as DSPL except display starts at channel XX.
18	DSPLC	Displays all system channels presently in CLOSED state.
19	DSPLO	Displays all OPEN channels.
20	DSPLA	Displays all channels presently in ALARM state.
21	DSPLN	Displays all channels presently in NORMAL state.
22	DSPLNC	Displays all system channels programmed as Normally Closed.
23	DSPLNO	Displays all system channels programmed as Normally Open.
24	DSPLNO/C	Displays every channel and its programmed status.
25	DSPLDEL	Displays all channels deleted from system.
26	DSPLMAN	Displays all manually deleted channels with descriptors.
27	DSPLAUT	Displays all automatically deleted channels with descriptors.
28	INH PRT	Places SER in suppressed print mode.
29	ENAPRT	Clears Inhibit Print mode.
30	RMT OFF	Disables remote teletype as output device.
31	RMT ON	Enables remote teletype as output device.
32	KYBD ON	Overrides keyswitch for remote keyboard.
33	KYBD OFF	Disables keyswitch override feature for remote TTY.
34	PRT OFF	Disables SER thermal printer.
35	PRT ON	Enables thermal printer.
36	PROGTEXT XXXX	Programs alphanumeric descriptors for SER system channels.
37	PROG XXXX	Programs both descriptor and status.
38	PROGP	Programs ALARM/NORMAL status of a channel.
39	SAVPOL	Saves programmed ALARM/NORMAL status in EEROM.
40	GETPOL	Moves status information from EEROM in RAM locations.
41	IDTEXT	Enables EEROM to store station identifier.
42	IDPRINT	Enables operator to print station identifier.
43	STATWDS	Overrides Alarm/Normal nomenclature.
44	LOAD	Programs descriptors from cassette tape.
45	STORE	Saves programmed descriptor on tape.
46	WRITE	Transfers contents of system EEROM to tape unit.
47	READ	Programs system EEROM from data saved on cassette tape.
48	MAPSYST	Prints summary of system's present status.
49	MAPSTAT	Prints O/C or A/N depending on present display mode.
50	PORT	Displays status of SER option switches. (Diagnostic use only)
51	RESET	Reinitializes unit (time and date not affected).
52	RESETIN	Reinitializes all system Input Boards.
53	SNGTEST	Strobes single-point-test relay (No. 8) on Alarm Contact Bd.
54	MEMORY	Used to test event data RAM locations.
55	TESTBDS	Tests all 32 channel boards.
56	TESTBD XX	Tests 32 channel board XX.

* Factory Test Only

Table 5-1 SER System Commands

Ref	Keyboard Entry Command	Function
57	AP TEST	Executes SER's all points test routine.
58	DIAGOFF	Disables ongoing input board diagnostics.
59	DIAGON	Re-enables diagnostic test routines.
60	* PROGEROM	Programs EEROM chips to known data.
61	* TESTEROM	Tests EEROM chips for known data.
62	* PROGERFF	Erases EEROM chips.
63	SETACC	Sets accumulator mode for display routines.
64	CLRACC	Disables accumulator mode.
65	SETTRAN XX	Inputs value for transition counter of channel XX.
66	SETELTM XX	Sets elapsed time accumulator for channel XX.
67	ZAELTM	Resets all channel elapsed time accumulators.
68	ZELTM XX	Resets elapsed time accumulators for channel XX.
69	ZATRAN	Resets all the channel transition counters.
70	ZTRAN XX	Resets transition counters for channel XX.
71	ZLNCT	Resets line counter.
72	ZEROACC	Zeroes all SER channel accumulators.
73	DELCHAN XX	Deletes designated channel from SER monitoring.
74	RESTORE	Restores all manually deleted channels.
75	RESTORE XX	Restores designated channel to system.
76	SET DEL XX	Sets automatic deletion counter to XX.
77	AUTOREST	Restores all automatically deleted channels.
78	PROGSEQ	Used to enter sequence of up to 255 steps.
79	DSPLSEQ	Displays programmed sequence.
80	DSPLLRN	Displays learned sequence.
81	MODSEQ	Modifies out of sequence data without reprogramming.
82	OUTSEQ XX M	Deletes event from out of sequence.
83	INSEQ XX M	Restores event for out of sequence.
84	MASKDSP	Displays all deleted out of sequence events.
85	MOVELRN	Moves learned sequence into programmed sequence locations.
86	ENASEQ	Enables out-of-sequence mode of SER operation.
87	TRIGSEQ XX	Used to enter trigger channel for out-of-sequence detection.
88	CLRSEQ	Clears programmed and learned sequence locations.
89	DISSEQ	Disables out-of-sequence detection interrupt routine.
90	SAVSEQ	Saves out-of-sequence program into EEROM.
91	GETSEQ	Moves saved out-of-sequence program into RAM locations.
92	PROGTRAP XX	Programs channel and O/C state into SER trap.
93	MODTRAP	Used to modify trap which is programmed.
94	DSPLTRAP XX	Displays all channels programmed into TRAP XX.
95	TRAPDESC XX	Programs descriptors for SER's programmable TRAPS.
96	TRAPDSPL	Prints summary of status of all SER's 15 TRAPS.
97	TRAPSTAT	Prints display of all TRAPS that presently exist.
98	ENATRAP	Enables TRAP detection.
99	DISTRAP	Disables TRAP detection.
100	CLRTRAP	Clears all TRAP data.
101	CLRTRAP XX	Clears TRAP number XX, making its occurrence impossible.
102	SETTRAP	Sets every channel into each of 15 TRAPS.
103	ZATPELT	Resets all elapsed time accumulators for TRAPS.
104	ZTPELTM XX	Resets only the elapsed-time accumulators for TRAP number XX.
105	ZATPTNC	Resets the transition counters for all TRAPS.
106	ZTPTNC XX	Resets transition counter for TRAP number XX.
107	PROGTIME	Programs out-of-time data tables.
108	MODTIME	Allows operator to modify programmed out-of-time routine.
109	DSPLTIME	Displays the out-of-time program saved in EEROM memory.
110	TRIGTIME	Enters channel XX as out-of-time trigger.
111	ENATIME	Enables out-of-time mode.
112	DISTIME	Disables out-of-time operation.
113	CLRTIME	Clears all out-of-time RAM locationss.
114	SAVTIME	Saves out-of-time program into EEROM.
115	GETTIME	Moves out-of-time program saved in EEROM into RAM memory.
116	△ PROGGATE XX	Programs GATES for Gate Analysis Software.
117	△ DSPLGATE XX	Displays contents of GATE XX.
118	△ GATEDESC XX	Programs descriptor for GATE XX.
119	△ GATESTAT	Displays the status of all 64 GATES.
120	△ CLRGATE XX	Resets GATE data.
121	△ DISGATE	Inhibits the Gate Analysis Software from operating.
122	△ ENAGATE	Permits the operation of Gate Analysis Software.
123	△ ENAPROM	Accesses memory location for Gate Analysis Software.
124	△ DISPROM	Disables any prior ENAPROM command.

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* Factory Test Only
△ Requires Factory Initiation - Not Normally Executable

Some of the frequently used commands listed in Table 5-1 may be executed using a single key on the front panel keyboard pictured in Fig. 5-1. The keycap labels and their respective commands are listed in Table 5-2.

Table 5-2. Dedicated Key Commands

Dedicated Key	Command	Function
PROG	PROG	Program both legend and status.
PROGT	PROGTEXT	Program channel descriptor legend.
PROGP	PROGP	Program channel Alarm/Normal status.
SET T	SET TIME	Set time clock.
SET D	SET DATE	Set the date.
DSPL	DSPL	Display the all system channels.
DSPL A	DSPLA	Display only system channels in Alarm.
MAP	MAPSYST	Summarize system status.

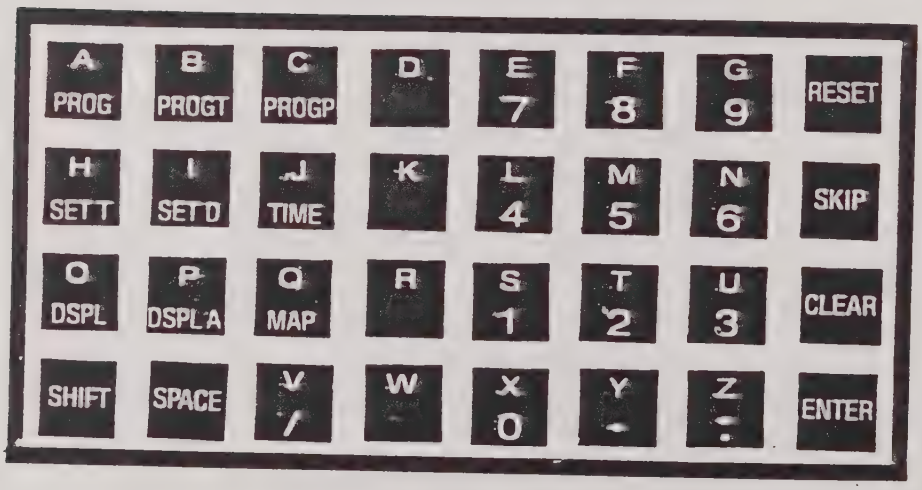

Figure 5-1. Front Panel Keyboard

Table 5-1 SER System Commands

Ref	Keyboard Entry Command	Function
1	TIME	Prints time and date on thermal printer and teletype.
2	INT TIME	Initializes time to 00:00:00.000
3	SET TIME XX:XX:XX:XXX	Programs internal time clock to HH:MM:SS.MSEC
4	SET DATE XX/XX/XX	Sets date MM/DD/YY.
5	ZMSMS	Resets minutes, seconds and milliseconds to zero.
6	ZRTM	Causes system to reprint last ZMSMS printout.
7	EXTTIME	Enables use of external time via keyboard.
8	XTAL	Forces SER to use own crystal oscillator as time base.
9	MATCHTIM	Matches SER's internal time check to external time base.
10	DAY	Daily function.
11	EIGHTHR	Eight hour function.
12	HOUR	Hour function.
13	HALFHR	Half hour function.
14	INTIME	Print internal time.
15	EXTIME	Print external time.
15A	DELTIME	Calculate and display internal/external time difference.
15B	* TESTBCD	Test routine for BCD inputs.
16	DSPL	Displays summary of all SER system inputs.
17	DSPL XX	Same as DSPL except display starts at channel XX.
18	DSPLC	Displays all system channels presently in CLOSED state.
19	DSPLO	Displays all OPEN channels.
20	DSPLA	Displays all channels presently in ALARM state.
21	DSPLN	Displays all channels presently in NORMAL state.
22	DSPLNC	Displays all system channels programmed as Normally Closed.
23	DSPLNO	Displays all system channels programmed as Normally Open.
24	DSPLNO/C	Displays every channel and its programmed status.
25	DSPLDEL	Displays all channels deleted from system.
26	DSPLMAN	Displays all manually deleted channels with descriptors.
27	DSPLAUT	Displays all automatically deleted channels with descriptors.
28	INH PRT	Places SER in suppressed print mode.
29	ENAPRT	Clears Inhibit Print mode.
30	RMT OFF	Disables remote teletype as output device.
31	RMT ON	Enables remote teletype as output device.
32	KYBD ON	Overrides keyswitch for remote keyboard.
33	KYBD OFF	Disables keyswitch override feature for remote TTY.
34	PRT OFF	Disables SER thermal printer.
35	PRT ON	Enables thermal printer.
36	PROGTEXT XXXX	Programs alphanumeric descriptors for SER system channels.
37	PROG XXXX	Programs both descriptor and status.
38	PROGP	Programs ALARM/NORMAL status of a channel.
39	SAVPOL	Saves programmed ALARM/NORMAL status in EEROM.
40	GETPOL	Moves status information from EEROM in RAM locations.
41	IDTEXT	Enables EEROM to store station identifier.
42	IDPRINT	Enables operator to print station identifier.
43	STATWDS	Overrides Alarm/Normal nomenclature.
44	LOAD	Programs descriptors from cassette tape.
45	STORE	Saves programmed descriptor on tape.
46	WRITE	Transfers contents of system EEROM to tape unit.
47	READ	Programs system EEROM from data saved on cassette tape.
48	MAPSYST	Prints summary of system's present status.
49	MAPSTAT	Prints O/C or A/N depending on present display mode.
50	PORT	Displays status of SER option switches. (Diagnostic use only)
51	RESET	Reinitializes unit (time and date not affected).
52	RESETIN	Reinitializes all system Input Boards.
53	SNGTEST	Strobes single-point-test relay (No. 8) on Alarm Contact Bd.
54	MEMORY	Used to test event data RAM locations.
55	TESTBDS	Tests all 32 channel boards.
56	TESTBD XX	Tests 32 channel board XX.

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* Factory Test Only

Table 5-1 SER System Commands

Ref	Keyboard Entry Command	Function
57	AP TEST	Executes SER's all points test routine.
58	DIAGOFF	Disables ongoing input board diagnostics.
59	DIAGON	Re-enables diagnostic test routines.
60	* PROGEROM	Programs EEROM chips to known data.
61	* TESTEROM	Tests EEROM chips for known data.
62	* PROGERFF	Erases EEROM chips.
63	SETACC	Sets accumulator mode for display routines.
64	CLRACC	Disables accumulator mode.
65	SETTRAN XX	Inputs value for transition counter of channel XX.
66	SETELTM XX	Sets elapsed time accumulator for channel XX.
67	ZAELTM	Resets all channel elapsed time accumulators.
68	ZELTM XX	Resets elapsed time accumulators for channel XX.
69	ZATRAN	Resets all the channel transition counters.
70	ZTRAN XX	Resets transition counters for channel XX.
71	ZLNCT	Resets line counter.
72	ZEROACC	Zeroes all SER channel accumulators.
73	DELCHAN XX	Deletes designated channel from SER monitoring.
74	RESTORE	Restores all manually deleted channels.
75	RESTORE XX	Restores designated channel to system.
76	SET DEL XX	Sets automatic deletion counter to XX.
77	AUTOREST	Restores all automatically deleted channels.
78	PROGSEQ	Used to enter sequence of up to 255 steps.
79	DSPLSEQ	Displays programmed sequence.
80	DSPLLRN	Displays learned sequence.
81	MODSEQ	Modifies out of sequence data without reprogramming.
82	OUTSEQ XX M	Deletes event from out of sequence.
83	INSEQ XX M	Restores event for out of sequence.
84	MASKDSP	Displays all deleted out of sequence events.
85	MOVELRN	Moves learned sequence into programmed sequence locations.
86	ENASEQ	Enables out-of-sequence mode of SER operation.
87	TRIGSEQ XX	Used to enter trigger channel for out-of-sequence detection.
88	CLRSEQ	Clears programmed and learned sequence locations.
89	DISSEQ	Disables out-of-sequence detection interrupt routine.
90	SAVSEQ	Saves out-of-sequence program into EEROM.
91	GETSEQ	Moves saved out-of-sequence program into RAM locations.
92	PROGTRAP XX	Programs channel and O/C state into SER trap.
93	MODTRAP	Used to modify trap which is programmed.
94	DSPLTRAP XX	Displays all channels programmed into TRAP XX.
95	TRAPDESC XX	Programs descriptors for SER's programmable TRAPS.
96	TRAPDSPL	Prints summary of status of all SER's 15 TRAPS.
97	TRAPSTAT	Prints display of all TRAPS that presently exist.
98	ENATRAP	Enables TRAP detection.
99	DISTRAP	Disables TRAP detection.
100	CLRTRAP	Clears all TRAP data.
101	CLRTRAP XX	Clears TRAP number XX, making its occurrence impossible.
102	SETTRAP	Sets every channel into each of 15 TRAPS.
103	ZATPELT	Resets all elapsed time accumulators for TRAPS.
104	ZTPELTM XX	Resets only the elapsed-time accumulators for TRAP number XX.
105	ZATPTNC	Resets the transition counters for all TRAPS.
106	ZTPTNC XX	Resets transition counter for TRAP number XX.
107	PROGTIME	Programs out-of-time data tables.
108	MODTIME	Allows operator to modify programmed out-of-time routine.
109	DSPLTIME	Displays the out-of-time program saved in EEROM memory.
110	TRIGTIME	Enters channel XX as out-of-time trigger.
111	ENATIME	Enables out-of-time mode.
112	DISTIME	Disables out-of-time operation.
113	CLRTIME	Clears all out-of-time RAM locationss.
114	SAVTIME	Saves out-of-time program into EEROM.
115	GETTIME	Moves out-of-time program saved in EEROM into RAM memory.
116	△ PROGGATE XX	Programs GATES for Gate Analysis Software.
117	△ DSPLGATE XX	Displays contents of GATE XX.
118	△ GATEDESC XX	Programs descriptor for GATE XX.
119	△ GATESTAT	Displays the status of all 64 GATES.
120	△ CLRGATE XX	Resets GATE data.
121	△ DISGATE	Inhibits the Gate Analysis Software from operating.
122	△ ENAGATE	Permits the operation of Gate Analysis Software.
123	△ ENAPROM	Accesses memory location for Gate Analysis Software.
124	△ DISPROM	Disables any prior ENAPROM command.

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* Factory Test Only
△ Requires Factory Initiation - Not Normally Executable

1 TIME

The "TIME" command prints the time and date to the thermal printer and peripheral teletype.

Note: This function clears the LED display timeout so that time will be updated to the display once per second. An "x" preceding the time and date on the LED display is an indication that time is derived from the external BCD time.

2 INT TIME

"INT TIME" initializes the time to 00:00:00.000.

3 SET TIME XX:XX:XX.XXX

"SET TIME" is used to program the event processor time clock. The format is HOURS:MINUTES:SECONDS.MILLISECONDS expressed in military time (i.e., hours go from 0 to 23, no AM or PM). The period is a necessary delimiter between second and milliseconds; however, the use of colons is optional.

If the incomplete entry format is used and no period is in the format, the system assumes a period at the end of the entered line. "What?" will be printed for invalid entries. Logical errors, such as hours greater than 24 will be responded to with "INVALID TIME" and a display of the present time. Incorrect entries do not alter the present time setting in any way.

4 SET DATE XX/XX/XX

The SER contains an infinite calendar algorithm. The algorithm accounts for leap years and advances the dates at midnight. It does not correct for daylight savings time. The data entry format is month/day/year with each number being a two digit value. Leading zeros must be used for single digit numbers (e.g. 08). Invalid entries are responded to with "INVALID DATE" if the entry is illogical, such as a month greater than 12. Incorrect entry format is responded to with a "WHAT?"

5 ZMSMS

ZERO TIME SYNC:

The "ZMSMS" command sets the value of minutes, seconds, and milliseconds to zero. If the minutes exceed 3Ø, then the hours value is incremented. "ZMSMS" will not be executed if any events are on the stack.

6 ZRTM

ZERO TIME MESSAGE:

"ZRTM" prints the "ZMSMS" error message.

7 EXTTIME

EXTERNAL TIME:

The "EXTTIME" provides a way to enable the use of external time via a keyboard. The external time must pass the same minimum specification as for the "MATCHTIM" command or else the function will not be executed but an error message will be printed instead.

Note: At the end of the day the SER will revert to the time keeping as defined by the slide switches on the real time board.

8 XTAL

INTERNAL TIME:

"XTAL" provides the operator with a way to force the SER to use its own' precision crystal oscillator module as its time base.

Note: At the end of the day the SER will revert to the time keeping as defined by the slide switches on the real time board.

9 MATCHTIM

CORRECT INTERNAL TIME:

"MATCHTIM" will set the SER's internal time clock to match the external time base. The external time must be found to be operating which minimumly requires that the millisecond-one digit is changing as expected. If this is the case, then the SER will set its internal time clock to match that of the external time base.

10 DAY

The "DAY" command offers the operator the means to execute the daily 24-hour routine directly from the keyboard. This bypasses the need to set time to midnight in order to cause this routine to be executed. The following functions are executed: DSPLA, AP TEST, and MATCHTIM if it is applicable.

11 EIGHTHR

"EIGHTHR" is the command to execute the functions that the SER does on 8-hour crossings. These commands are: "DSPLAUT" and "AUTOREST".

12 HOUR

The "HOUR" command allows the operator to simulate an hour crossing and to execute all of the functions which the SER does at that time. At this time, the SER recalculates the number of boards in the system and reenables external time if allowable.

13 HALFHR

The "HALFHR" command allows the operator to execute the functions which are normally executed at half-hour crossings. At this time the unit queries the switches located on the EEROM Control board which enable the Process Analyzer and Accumulator modes. This means that if a switch is changed when the unit is operating, time must cross a half hour before the operating modes are changed. The single point test relay is strobed via this command on the half hour, and the external time diagnostics error flags are cleared at this time to restart the error detection if the external time has failed.

14 INTIME

The "INTIME" command provides a way to print out the internal time clock's time even if the unit is using the external time base for time of day. This command does not affect which time base is being used.

15 EXTIME

The "EXTIME" command provides the means to print out the external BCD time clock's time even if the unit is using the internal time base for time of day. This command does not affect which time base is being used.

15A DELTIME

The "DELTIME" command calculates the relative time difference between the internal and external time sources and displays it. The delta time is calculated by subtracting the internal from the external time. The command also prints the internal time for reference. If the internal time leads the external time, the delta time hours will be greater than 12. This is the equivalent to a negative time. The "DELTIME" command may be useful for finding an open or shorted pin on the BCD inputs.

15B TESTBCD

"TESTBCD" is a command which may be useful for troubleshooting the external time connections. The program will cause the SER to print out the time on the BCD inputs whenever it changes. In this mode, a technician could apply a logic voltage between individual time bits and the return to expedite finding shorts and opens in the connections. "Control C" or "Skip" will terminate this function.

16 DSPL

"DSPL" will summarize all of the inputs in the SER system. It will display in terms ALARM/NORMAL or OPEN/CLOSED depending upon the display mode which has been set. Channels which are not in the system are designated by "***". Each channel number has a state and descriptor displayed. The Transition Counter and elapsed time information is also presented when the accumulator mode is set. A channel will be printed only if it presently exists within the system or if it has a valid descriptor. Channels that are not in the system and that do not have descriptor memory will not be printed. Non-existent channels that have valid descriptor memory can be suppressed from printing if the descriptor is programmed with exactly four characters.

17 DSPL XX

"DSPL XX" is exactly the same as DSPL except that the operator designates the display starting point "XX". All channels from the entered point on are displayed.

18 DSPLC

DISPLAY CLOSED:

"DSPLC" will display all of the system channels presently in the closed (or conducting) state. The display format is: channel number, state, and descriptor. The open/closed displays may also contain the accumulator information if the mode has been set (SETACC).

19 DSPLO

DISPLAY OPEN:

"DSPLO" will display all the non-conducting or "OPEN" channels. The display format is: channel number, state and descriptor. If the accumulator display mode has been set (SETACC), the transition counter and elapsed time will also be displayed. The OPEN/CLOSED display format is set (as opposed to ALARM/NORMAL).

20 DSPLA

DISPLAY ALARM:

"DSPLA" will display all of the channels presently in the "ALARM" state. The display format is: channel number, state, and the alpha-numeric descriptor. If the accumulator mode has been set, transition counter and elapsed time are displayed also. The ALARM/NORMAL printout mode is set (as opposed to OPEN/CLOSED).

21 DSPLN

DISPLAY NORMAL:

"DSPLN" will display all of the channels presently in the "NORMAL" state. The display format is channel number, state, and descriptor. If the accumulator mode has been set, transition counters and elapsed time are also displayed.

Note: "DSPLA" and "DSPLN" set the ALARM/NORMAL mode for printing. This will cause the event data to be printed in terms of ALARM or NORMAL and the "DSPL" command to display ALARM/NORMAL information.

22 DSPLNC

DISPLAY NORMALLY CLOSED:

"DSPLNC" will display all system channels which have been programmed to be normally closed. The display format is the same as DSPLA. It prints channel number, programmed state, and the descriptor.

23 DSPLNO

DISPLAY NORMALLY OPEN:

"DSPLNO" will display all system channels which have been programmed to be normally open. It is the converse of DSPLNC and the format is similar in all respects.

24 DSPLNO/C

DISPLAY NORMALLY OPEN/CLOSED:

"DSPLNO/C" displays every channel and its programmed status. It is the combination of the DSPLNC and DSPLNO commands.

25 DSPLDEL

DELETE DISPLAY:

"DSPLDEL" gives a display of all the channels deleted from the system, either manually or automatically. Manually deleted channels will print "DELETED" and automatically deleted channels will print DEL/AUTO. Accumulator information and descriptors are printed (as in DSPLA or any other displays) if the accumulator mode is set.

26 DSPLMAN

MANUAL DELETE DISPLAY:

"DSPLMAN" displays all of the manually deleted channels, with their respective descriptors.

27 DSPLAUT

AUTO-DELETE DISPLAY:

"DSPLAUT" displays all of the automatically deleted channels with their respective descriptors.

28 INH PRT

INHIBIT PRINT:

"INH PRT" puts the SER in a suppressed print mode.

To retrieve the information saved in memory, the operator uses the "ENA PRT" command.

Note: When in the "OUT-OF-SEQUENCE" detection mode, the unit is not allowed to be used in the suppressed printing mode. If the operator attempts to inhibit printing, the unit will initiate an enable print command to assure printing is continuous.

29 ENA PRT

ENABLE PRINTING:

"ENA PRT" clears the "INHIBIT PRINT" mode and permits the SER to print out all the stack faults which it is presently maintaining in memory. If, while in the suppressed print mode, the SER recognized more events than the number of stack faults allowed, then the print will reflect this by printing a "MEMORY OVERFLOW" message. An "OVERFLOW" condition represents exceeding the system's capabilities and normal operation will not resume until printing is completed.

30 RMT OFF

REMOTE OFF:

The "RMT OFF" command disables the remote teletype as an output device. Its input capabilities are unaffected. In the event that the TTY is the only active output device at the time, the SER will initiate a "RMT ON" command thereby insuring at least one active output device.

31 RMT ON

REMOTE ON:

"RMT ON" enables the remote teletype as an output device.

32 KYBD ON

KEYBOARD ON:

"KYBD ON" enables the remote TTY keyboard as an input device regardless of the front panel switch position. This allows the key to be put into the "OPERATE" position, and still have the ability to input all commands from the remote keyboard.

Note: This feature is disabled during a "POWER ON" or "RESET".

33 KYBD OFF

KEYBOARD OFF:

"KYBD OFF" disables the keyswitch override feature for remote TTY.

34 PRT OFF

PRINTER OFF:

"PRT OFF" disables the SER thermal printer as an output device. In the event the thermal printer is the only active output device, the SER will initiate a "PRT ON" command, thus insuring there is at least one active output device. The thermal printer is active on power on.

35 PRT ON

PRINTER ON:

"PRT ON" enables the thermal printer as an output device.

36 PROGTEXT XXXX

PROGRAM CHANNEL DESCRIPTOR:

Alphanumeric descriptors for SER system channels are programmed using the "PROGTEXT" and specifying a valid channel number. If no channel number is specified, text entry will begin with channel one. When the line of text is completely entered, the unit will save the text in EEROM and prompt with the next successive channel. To change the prompt to another channel, the operator enters the desired channel number in the format in which the SER prints (i.e., the number must be four digits using leading zeros if necessary, e.g. 0004). The SER will then reprompt with this channel and descriptor programming can resume as above. To terminate the program, the operator enters Control C or skip. An ENTER (RETURN) as the first character of a prompt entry will also terminate the programming sequence.

37 PROG XXXX

The "PROG XXXX" command is useful when the operator wishes to program both the channel descriptor and ALARM/NORM status at the same time. The unit will prompt with the channel number for the descriptor text. After the descriptor has been entered, the unit will save this information and then will prompt for the status information. Data entry and reprompting is identical to that in the "PROGTEXT" and "PROGP" commands.

38 PROGP

PROGRAM CHANNEL STATUS:

The ALARM/NORMAL status of a channel is programmed using the "PROGP" command. The status word "ALARM or NORMAL" is assigned to the OPEN state of the particular channel. The system prompts with "XXXXN/" and waits for an operator entry of the contacts normal condition where XXXX is the channel number. Proper entries are "O" for open and "C" for closed. Prompting occurs in sequential channel order. The prompted channel number may be modified by entering the desired channel number. This will have no affect on the programmed state of the channel. At the completion of programming, the data is saved in EEROM.

39 SAVPOL

SAVE CHANNEL STATUS: *

"SAVPOL" saves the programmed ALARM/NORMAL status for channels into EEROM.

40 GETPOL

GET CHANNEL STATUS: *

"GETPOL" moves the status information saved in EEROM memory into the RAM locations which the SER uses when processing ALARM/NORMAL information.

NOTE: The "GETPOL" function is automatically performed during the SER's power on and reset initialization.

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* These functions are executed automatically when required and therefore not normally required to be executed by the operator.

41 IDTEXT

STATION IDENTIFIER:

The SER provides EEROM memory to allow the operator to program a 32 character station identifier. This identifying text will be printed on power-on and at the end of each print sequence. After entering the command the SER will accept the text string. In the event more than 32 characters are entered, only the first 32 will be programmed.

42 IDPRINT

The "IDPRINT" command allows the operator to print the station identifier. The identifier is programmed by the "IDTEXT" command and is printed at the end of each event printing sequence.

43 STATWDS

PROGRAMMABLE STATUS WORDS:

The SER's programmable status words allow the user to over-ride the Alarm/ Normal nomenclature. Executing the "STATWDS" command will cause the SER to prompt the operator for the new status words. This is done by printing "ALARM/" or "NORM /" and waiting for the replacement word to be entered. The new status word may be up to 8 characters long. The alternate nomenclature will then be used during event printing and displays.

The use of status words may be disabled by entering a "SKIP" or control C in response to either of the prompts. To re-enable existing status words, the operator types an "ENTER" for each prompt. The "ENTER" may also be used to skip over a status word in the event it is necessary to execute the command to change one.

44 LOAD

LOAD DESCRIPTORS FROM TAPE:

The "LOAD" routine programs the EEROM descriptor memory with the text which has been saved on cassette tape. The unit has a 30 second "time out" to wait for the tape to rewind. If the tape is rewound, a Control C will end the programming, otherwise it stops when all text has been programmed.

Note: As with the "WRITE" command, the thermal printer is shut off during execution of the "LOAD" routine, and restored to its previous status upon completion.

45 STORE

STORE DESCRIPTORS ON TAPE

The "STORE" command allows the user to save the programmed descriptor on the optional tape unit. The unit waits 30 seconds to allow the tape unit to rewind, and then begins sending the programmed descriptors. If the tape is already rewound, a Control C will override the 30 second timeout and it will begin sending data.

Note: The thermal printer is shut off during the write routine, and is then restored to its previous status.

46 WRITE

SAVE EEROM ON TAPE:

The "WRITE" command transfers the contents of the system EEROM to the optional tape unit. The unit waits 30 seconds for the cassette tape to rewind and then begins transferring data. If the tape is already rewound, a Control C will override the 30 second interval. The data is transferred 32 bytes at a time. The EEROM address is transferred, followed by 64 characters. These 64 characters are the hexidecimal equivalents of the EEROM data.

47 READ

PROGRAM EEROM FROM TAPE:

The "READ" command programs the system EEROM from data saved on cassette tape. The tape unit sends the EEROM address and the data to be programmed. This data is transferred as 64 hexidecimal characters which are then compressed into 32 bytes and programmed. If an invalid character is found, an error message is printed. The transfer then continues.

48 MAPSYST

MAP SYSTEM:

"MAPSYST" prints a summary of the system's present status on a board-by-board basis. The open/closed state of the channels is printed and under each state is the programmed alarm/normal status for this condition.

49 MAPSTAT

MAP STATUS:

"MAPSTAT" is an abbreviation of map system. This function prints out the open/closed data or the alarm/normal data, depending on the display mode the unit is presently in.

Note: To change display modes one can execute a display function of the type of output desired (i.e. DSPLA or DSPLC). This will set the display mode to A/N or O/C.

50 PORT

SWITCH PORT TEST:

The "PORT" command displays the status of the SER option switches. The data is represented as eight 1's and 0's, where a "0" means the option is enabled and a "1" means it is disabled. (Refer to the table below for bit designations.) The SER will remain in the port function program until the operator enters a Control C. While performing the function, the unit will print the new switch status every time a switch setting is changed.

Note: The SER interrupt is disabled during the execution of the "PORT" command. When the routine is terminated, the unit will record an event if the state of a channel is different than it was when the function was entered.

BIT DESIGNATIONS

BIT	PHYSICAL LOCATION	FUNCTION	"0"	"1"
BIT 7*	Front Panel Keyswitch	SET/OPERATE	SET	OPERATE
BIT 6		Future Expansion	-	-
BIT 5	Inner Rear Panel	OPTION ENABLE/ DISABLE	ENABLE	DISABL
BIT 4	Inner Rear Panel	PRINT ALWAYS	ENABLE	DISABLE
BIT 3	Inner Rear Panel	LINE COUNTER	ENABLE	DISABLE
BIT 2	Inner Rear Panel	TRIGGER PRINT	ENABLE	DISABLE
BIT 1	Inner Rear Panel	SNAPSHOT	ENABLE	DISABLE
BIT Ø	Inner Rear Panel	SELECTED MONITORING	ENABLE	DISABLE

*Bit 7 is on the extreme left of the display.

51 RESET

SYSTEM RESET:

"RESET" initializes the SER in the same manner as power-on with the exception of the time and date.

52 RESETIN

RESET INPUT BOARDS:

"RESETIN" reinitializes all Input Boards in the system and sets their programmed status to "NORMALLY OPEN". The command also prints out the number of valid boards it has found in the system. Because the command resets the programmed status, this command should be followed by a GETPOL where applicable. All deleted channels are also restored.

53 SNGTEST

SINGLE POINT TEST:

"SNGTEST" strobes the single-point-test relay (relay #8) on the ALARM CONTACT BOARD (2211-O-401).

Note: The unit initiates a single-point-test every hour on the half-hour.

54 MEMORY

MEMORY:

The "MEMORY" command is used to test the RAM locations where event data is stored. If defective RAM is found, the unit will truncate the event storage at the occurrence of the defective location, thus allowing normal operation to continue but with reduced storage memory. The command responds with "MIN EVENTS = XXX". Under normal conditions, the minimum number of events allowed is 398. If the unit calculates anything less than 398, then it has found a RAM error.

Notes: 1) Exercise care when using the memory command. Any data within RAM memory is destroyed when the test is performed and the data handling pointers are reset.

2) This command is automatically executed after a memory overflow condition.

55 TESTBDS

All the 32-channel input boards may be tested and initialized from the keyboard using the "TESTBDS" command. This command executes the routines which are used to initialize an input board on power-on. If a board is not initialized, the unit will print out an error message which will specify suspected reasons for the board's malfunction. The program will attempt to initialize all possible 32-channel input boards. For further details of the 32-channel board and its testing, refer to TM-111075.

56 TESTBD XX

A 32-channel input board may be tested and initialized from the keyboard using the "TESTBD XX" command. This command executes the routines which are used to initialize an input board on power-on. If the board is not initialized, the unit will print out an error message which will detail suspected reasons for the board's malfunction. For more details concerning the 32-channel board and its testing, refer to TM-111075.

57 AP TEST

32 CHANNEL ALL POINTS TEST:

The "AP TEST" command will execute the SER's all points test routine. This routine allows the system to exercise the 32 channel boards under software control. When the command is executed the system turns on each and every comparator on the front end of the 32 channel input boards. It then checks for the proper changes of state on these boards and deletes all incorrect channels. The program then restores the board to its original status and initiates a display of all channels which have been deleted.

58 DIAGOFF

DIAGNOSTICS OFF:

"DIAGOFF" provides a means by which to disable the ongoing input board diagnostics.

59 DIAGON

"DIAGON" reenables the ongoing diagnostic programs if they have been turned off at a prior time. The front panel LED display will periodically flash a "DIAG OFF" message if the diagnostics have been inhibited.

60 PROGEROM

The "PROGEROM" command is used in conjunction with the "TESTEROM" command. "PROGEROM" programs the EEROM descriptor memory with known ASCII data. The worst case time for this command to program 64K of data is 2-1/2 hours.
CAUTION: This command should never be executed after channel descriptors have been programmed. If it is, this data will be irretrievably lost.

61 TESTEROM

The "TESTEROM" commands test the descriptor legends for the data which the "PROGEROM" command programmed in the EEROM chips. If no errors are found in a chip, the unit will print a number from 1 to 32 corresponding to the chip. In this way, chips which will not retain data or are not present may be found by the conspicuous absents from the list of numbers.

62 PROGERFF

"PROGERFF" is identical to the "PROGEROM" command except that it programs each EEROM location through a hexidecimal FF. This is the erasure condition for the devices. It may be useful to execute this command on troublesome EEROM boards in order to reach a known state prior to executing the "PROGEROM" and "TESTEROM" routines. The worst case time for this command to program 64K of data is 2-1/2 hours.
CAUTION: This command should never be executed after channel descriptors have been programmed. If it is, this data will be irretrievably lost.

63 SETACC

SET ACCUMULATOR MODE:

"SETACC" sets the accumulator mode for the display routines. When it is enabled, all channel and TRAP displays print the SER accumulators (i.e. transition count and elapsed time information). The reoccurrence count will also be printed during event printing.

64 CLRACC

CLEAR ACCUMULATOR MODE:

"CLRACC" disables the accumulator mode. No transition counters or elapsed time information is printed during any display functions.

65 SETTRAN XX

SET TRANSITION COUNT FOR A CHANNEL:

"SETTRAN XX" is used to input a value for the transition counter of channel XX. The SER will prompt with "COUNT =" and will wait for the user entry. The user entry, a number up to six digits, will be set into the transition count accumulator for channel XX.

66 SETELTM XX

SET ELAPSED TIME FOR A CHANNEL:

"SETELTM XX" is used to set the elapsed time accumulator for channel "XX". After entry of the command and desired channel number, the SER will prompt with a "*" and wait for the operator entry. The entry format is to enter the time in seconds. Up to 9999 seconds can be entered. Numbers greater than four digits are not acceptable.

Note: Accumulator displays display elapsed time in conventional HOURS:MIN:SEC's so the time entered will differ in format from the displayed time.

67 ZAELTM

ZERO ALL ELAPSED TIME ACCUMULATORS:

"ZAELTM" resets all channel elapsed time accumulators to 0000:00:00.

68 ZELTM XX

ZERO ELAPSED TIME ACCUMULATOR XX:

"ZELTM" resets the elapsed time accumulators for channel "XX" to 0000:00:00.

69 ZATRAN

ZERO ALL TRANSITION COUNTERS:

"ZATRAN" resets all of the channel transition counters to 000000.

70 ZTRAN XX

ZERO TRANSITION COUNTER XX:

"ZTRAN" resets the transition counters for channel XX to 000000.

71 ZLNCT

ZERO LINE COUNTER:

"ZLNCT" resets the line counter.

72 ZEROACC

*ZERO ACCUMULATOR:

"ZEROACC" executes the "ZAELTM", "ZATRAN", and "ZLNCT" functions, thereby zeroing all the SER channel accumulators.

73 DELCHAN XX

DELETE A CHANNEL:

To delete a channel from being monitored by the SER, the user enters the "DELCHAN XX" command. This will essentially remove the channel from the system. A deleted channel will not be recorded and transition data is not placed in memory. Some restrictions apply with respect to trigger print and prefault operations.

74 RESTORE

RESTORE ALL CHANNEL:

"RESTORE" restores all channels to the system. This command restores the channel to the system even if it was manually or automatically deleted. This function is done during a RESETIN command.

75 RESTORE XX

The RESTORE XX command will restore a deleted channel to the system, where the XX denotes the channel number. Both the automatic and manual deletion conditions are cleared by this command.

76 SET DEL XX

SET DELETE:

Sets the automatic deletion counter to the value XX using the "SET DEL XX" command. When set, the SER will then delete a channel if it occurs more times than the value set in one print cycle. The unit will print the value of the deletion count after being set if a value (of XX) is not specified.

Note: The SER initiates an "AUTOREST" command every 8 hours. The present value will be printed in the command.

*This function is performed during the power-on start up sequence.

77 AUTOREST

RESTORE AUTO DELETED CHANNELS:

"AUTOREST" restores all automatically deleted channels to the system.

78 PROGSEQ

PROGRAM SEQUENCE:

"PROGSEQ" is used to enter a sequence of up to 255 steps. The unit will prompt with the sequence step number being programmed and wait for a user entry. The operator must then enter a channel-state combination. There must be a space between the channel number and state - an "O" denotes an open state and a "C" a closed state. Any input errors will cause an "INVALID ENTRY" error message and a reprompt with the same step number. Care must be taken when programming step <001>. This must contain the trigger channel. The trigger channel and the trigger must be a CLOSED state.

Note: When using the front panel keyboard the SER inserts the space after the number and does the shift function. Therefore, the programmer needs only to enter the number and then to push the "O" or "C" key.

79 DSPLSEQ

DISPLAY SEQUENCE:

"DSPLSEQ" displays the programmed sequence. The display will show the channel, state, and alphanumeric descriptor for each step in the sequence. When the sequence table has been displayed, the SER initiates a "MASKDSP" command to display the channels which are not being monitored by the out-of-sequence detection routine.

80 DSPLLRN

DISPLAY LEARNED SEQUENCE:

"DSPLLRN" displays the learned sequence in same fashion as the "DSPLSEQ" command displays the programmed sequence.

81 MODSEQ

MODIFY SEQUENCE:

The "MODSEQ" routine allows the operator to modify the programmed sequence data. When executing the modify routine, the SER works on a line-by-line basis. It will display a step of the sequence denoted by the step number, < 001 > , and then display the channel number and open or closed status programmed for this step. At this point, the system will prompt the operator to enter an instruction as to how to proceed. There are seven options, as follows:

1) If the step displayed is programmed properly, the "RETURN" (ENTER) key will advance the pointer to the next step in the sequence and that step will be displayed. With the "RETURN", the operator can step through the programmed sequence.

2) If the step has been programmed with the incorrect OPEN/CLOSED status, then the status can be changed by entering an "O" for OPEN and "C" for CLOSED. The new program step will then be displayed for verification.

3) If the step has been programmed with the incorrect channel number, then the entire line can be changed by entering the new data in the same format as "PROGSEQ" uses (i.e. channel number and "O" or "C" with a space separating them). Again the unit will display the step for verification.

4) If the programmed step is erroneous and is not to be replaced, then the "DELETE" or "CLEAR" key will remove it from the sequence. This will move all subsequent steps up one position in the program, shortening the sequence program by one step.

5) To insert a step to a sequence, the user enters "I" space followed by the channel number and status. This will move the previous data for this step and all subsequent steps down one in the program and reprogram the step with the new data.

6) To move the modify pointer within the programmed sequence, enter a number between 1 and 255 and the pointer will move to that step. This step will then be displayed and normal modify operation will resume.

7) To exit the modify program, the operator enters a "SKIP".

82 OUTSEQ XX M

OUT-OF-SEQUENCE:

"OUTSEQ" provides the user with a way of ignoring a channel or a specific channel (XX) and state (M) combination when detecting sequences. The user enters the channel number and "O" for open and "C" for closed to ignore a channel-state combination, If "O" or "C" is not entered, both states are deleted. The operator is not allowed to ignore an event that is in the program cycle data for "Out-of-Sequence".

Note: The space between the channel # and state must be present.

83 INSEQ XX M

IN SEQUENCE:

"INSEQ" restores a channel-state (XX-M) combination to be monitored by the SER. Information is entered by the criteria as in "OUTSEQ".

84 MASKDSP

MASK DISPLAY:

"MASKDSP" displays all the channel-state combinations which the out-of-sequence detection routine is ignoring. It displays the channel number and either "OPEN", "CLOSED", or "BOTH" to designate the deleted state.

85 MOVELRN

MOVE LEARN:

"MOVELRN" moves the learned sequence into the programmed sequence locations. The command does not affect the sequence-don't-care-masks. This command is particularly useful when "LEARNING" a known good sequence.

86 ENASEQ

ENABLE SEQUENCE:

"ENASEQ" enables the out-of-sequence mode of SER operation. If the print option switch on the rear panel or the "OUT-OF-TIME" mode is enabled, a "DISSEQ" command is immediately executed. Out of Sequence detection is not compatible with Out of Time or Prefault.

87 TRIGSEQ XX

TRIGGER SEQUENCE:

"TRIGSEQ XX" is used to enter the trigger channel for out-of-sequence detection. This command also executes an "ENASEQ". If no channel number (XX) is entered, it defaults to the first event programmed in the sequence.

Note: The trigger channel must be the first channel in the programmed sequence, and it must be going to a "CLOSED" state. If the trigger is not defined as the first event, the sequence will immediately become "Out of Sequence".

88 CLRSEQ

CLEAR SEQUENCE:

"CLRSEQ" clears the programmed and the learned sequence locations, and restores all channel masks.

89 DISSEQ

DISABLE SEQUENCE:

"DISSEQ" disables the out of sequence detection interrupt routine and returns the SER to normal operation. If any partial sequences are in progress, the function also forces an "UNEXPECTED TRIGGER" condition so the partial sequence is "LEARNED".

90 SAVSEQ

SAVE OUT OF SEQUENCE:

"SAVSEQ" saves the out-of-sequence program into EEROM. It prints a "*" for each 128 byte block it saves, and transfers 6 blocks in all. This function is performed automatically after the program and modify routines.

91 GETSEQ

GET OUT OF SEQUENCE:

"GETSEQ" moves the saved out-of-sequence program into the out-of-sequence RAM locations. This function is performed automatically prior to the display, program, and modify sequence routines.

92 PROGTRAP XX

PROGRAM TRAPS:

"PROGTRAP" programs the channel and respective OPEN/CLOSED state into one of the SER's 6 TRAPS. Programming TRAPS is slightly different than other programming routines in that the SER will prompt a channel number and a state. It will then wait for an operator entry of which there are five options:

1) "ENTER" or a carriage return will enter the displayed channel and state into the TRAP and will prompt with the next successive channel.

2) "CLEAR" or delete will not put the channel in the TRAP, but will move on to the next successive channel.

3) If the state displayed is not correct, then it can be changed by entering "O" if open is desired or "C" for closed.

4) To proceed directly to a desired channel, the reprompt format can be used. For this case, the operator enters the number of the channel he wishes to program into the TRAP. All channels between the channel displayed and the channel # entered are not put into the TRAP if they are not already in the TRAP. The SER will then display this channel and a state and will wait for an operator entry.

5) "SKIP" (Control C) will exit the program TRAP routine.

93 MODTRAP

MODIFY TRAPS:

"MODTRAP" is used to modify a TRAP which is already programmed. The operator instructions are the same as in the "PROGTRAP" command with only slight variations. The five options are as follows:

1) "ENTER" or carriage return will leave the displayed channel unchanged and will prompt with the next successive channel which is programmed in the TRAP.

2) "CLEAR" or delete will remove the channel from the TRAP and will prompt with the next programmed channel.

3) To change the state of a TRAP channel the operator enters "O" for open and "C" for closed and that will become the programmed state.

4) To jump to existing TRAP channels, the operator enters the channel number which he wished to modify. The SER will then prompt with this channel if it is in the TRAP. If the channel number entered is not programmed into the TRAP, then the next successive channel in the trap will be prompted.

5) "SKIP" (Control C) will exit the routine.

94 DSPLTRAP XX

DISPLAY TRAPS:

"DSPLTRAP XX" will display all of the channels programmed into TRAP "XX". Each channel is displayed with its OPEN/CLOSED state and corresponding alphanumeric descriptor.

95 TRAPDESC XX

TRAP DESCRIPTORS:

The alphanumeric descriptors for the SER's programmable TRAPS are programmed using the "TRAPDESC XX" command where "XX" denotes a TRAP number from 1 to 16. The TRAP descriptors have a fixed 32 character length. After the text has been typed in and entered, the SER will prompt with the next sequential TRAP. To program a TRAP other than the one with which unit is prompting, the number of the desired TRAP can be entered in the SER's printing format (i.e., the number must be four digits with leading zeros when necessary, e.g. 0011). The SER will then reprompt with the TRAP number entered.

96 TRAPDSPL

TRAP DISPLAY:

"TRAPDSPL" prints a summary of the status of all of the SER's 16 TRAPS. The TRAPS can be in one of three states. "NO TRAP" means the TRAP is programmed but the TRAP condition does not exist. "TRAP" is printed if the programmed TRAP presently exists, and "***" is printed if this TRAP has not been programmed. For each TRAP, the transition count and elapsed time accumulators are displayed along with the corresponding alphanumeric descriptor.

97 TRAPSTAT

TRAP STATUS:

"TRAPSTAT" prints a display of all the TRAPS which presently exist. No accumulator information or descriptors are printed.

98 ENATRAP

ENABLE TRAPS:

"ENATRAP" is a command which will enable trap detection for all traps which have been previously programmed. This command is executed automatically during the power-on and reset sequences. In addition to the individual trap enable flags, there is also a flag to enable trap detection. This flag which indicates that traps were enabled is saved in EEROM to be maintained through a power-down.

99 DISTRAP

DISABLE TRAPS

"DISTRAP" is the command by which trap detection may be disabled.

100 CLRTRAP

CLEAR TRAPS:

"CLRTRAP" clears all TRAP data. It also disables the TRAP detection mode.

101 CLRTRAP XX

CLEAR TRAP:

"CLRTRAP XX" clears TRAP number "XX", making its occurrence impossible.

Note: "PROGTRAP XX" does a "CLRTRAP XX" before prompting for data to be programmed.

102 SETTRAP

SETTRAP:

"SETTRAP" sets every channel into each of the TRAPS.

103 ZATPELT

ZERO ALL TRAP ELAPSED TIME:

"ZATPELT" resets all the Elapsed-Time-Accumulators for the SER's programmable TRAPS to 0000:00:00.

104 ZTPELTM XX

ZERO TRAP ELAPSED TIME XX:

"ZTPELTM XX" resets only the Elapsed-Time-Accumulators for TRAP number XX to 0000:00:00.

105 ZATPTNC

ZERO ALL TRAP TRANSITIONS:

"ZATPTNC" resets all TRAP transition counters to 000000.

106 ZTPTNC XX

ZERO TRAP TRANSITION XX:

This function resets the transition counter for TRAP number XX to 000000.

107 PROGTIME

PROGRAM OUT-OF-TIME:

"PROGTIME" programs the out-of-time data tables. The SER will perform a "CLRTIME" to initialize the working RAM locations, and then prompt the programmer for four items. They are the event channel and state, reference channel and state, relative event-time, and the tolerance. A syntax error will be responded to with an error message and a reprompt for the information. The format for the channel number and state is the same as for "PROGSEQ". The channel number must be separated from the state by a space. When using the front panel keyboard the SER inserts the space and shifts to the upper case for the state. Therefore to enter "1" closed, the programmer would enter the "1" and immediately press the "C" key. The time entry can be in the long or short time format. The range of long time will extend from 10 hours to hundreds of milliseconds and short time will extend from 59 minutes to milliseconds.

Whichever time format is chosen for relative time will be impressed upon the tolerance. Long tolerance extends from 59 minutes to hundreds of milliseconds and short tolerance extends from 59 seconds to milliseconds. The rules for inputting time are the same as those for setting the SER clock. The colon delimiter between HOURS:MIN:SEC is optional, but the decimal point between seconds and milliseconds is necessary. Partial times may be entered but if no decimal point is present, the SER will assume one at the end of the line. All unspecified values are forced to be equal to zero.

If for any reason an entire table entry is incorrect, a Control C will delete that entire entry and cause a reprompt for event channel and state data. A Control C when the unit is prompting for channel/state data is used to exit the routine. If the operator is programming a "PSEUDO-TRIGGER", the SER will first check to see if it conforms to the guidelines for triggers (references). If this convention is violated, then the SER will print an error message and reprompt, otherwise it will force "O" 's for the relative time and tolerance, and continue to the next table entry.

When this routine is over, the SER saves the program in EEROM, and tests the first table entry for a valid trigger. If the entry is a programmed trigger, it will assume it is the trigger channel and enable out of time detection.

108 MODTIME

MODIFY OUT OF TIME:

The "MODTIME" routine allows the operator to modify the programmed out-of-time routine. The modify routine works with table entries. A table entry consists of event channel, reference channel, time and tolerance. Entire entries can be manipulated but modifications within an entry are not allowed. After it has displayed the entry, the SER will print a "*" and wait for an operator command. There are six options. They are as follows:

OPERATOR COMMANDS:

1) A carriage return will advance the pointer to the next table entry and display it, leaving the last one intact.

2) The "DELETE" key will delete the entire table entry, and shift all subsequent entries up. The unit will display the new entry which now occupies the space which the old (now deleted) entry occupied.

3) To move the pointer within the programmed table, the operator can use the reprompt format. He need only enter the number between 1 and 255, or the entry he wishes to modify and the SER will print out that entry prompt for one of the modify commands.

4) If something in a table entry is incorrect, the entire entry must be replaced. An "R" will cause the SER to prompt for data, just as it does in "PROGTIME", to be inserted in place of the entry which has been displayed.

5) To insert a table entry, the operator types an "I". This will move the displayed entry and all subsequent entries down and then prompt for new data. This data is entered in the same fasion as "PROGTIME". The SER will then display the new entry for verification.

6) A "SKIP" (Control C) terminates the modify mode. When this routine is ended, it does a "SAVTIME" function, and attempts to use the first table entry as the trigger.

109 DSPLTIME

DISPLAY OUT OF TIME:

"DSPLTIME" is used to display all of the data table entries in the out-of-time program. The display is of the program stored in this EEROM.

110 TRIGTIME XX

TIME-TRIGGER CHANNEL:

"TRIGTIME XX" enters channel XX as the out-of-time trigger. If no channel number is entered, the trigger will default to the first channel in the program. When this channel goes to the "CLOSED" state, the out-of-time detection is enabled. The command also performs an ENATIME function. If Out-of-Time is prohibited from being enabled, the SER will print the error messages but the trigger channel has still been saved.

111 ENATIME

ENABLE OUT-OF-TIME:

"ENATIME" is used to enable the out-of-time mode. If the SER's selected monitoring switch is enabled, or if out-of-sequence is enabled, out of time is not permitted. An error message will be printed out and the "DISTIME" function will be executed to disable out-of-time.

112 DISTIME

DISABLE OUT-OF-TIME:

"DISTIME" will disable the out-of-time detection routine and return the SER to normal operation. It does not affect the programmed trigger.

113 CLRTIME

CLEAR OUT-OF-TIME:

"CLRTIME" clears all the out-of-time RAM locations. These are the locations when programming or modifying the out-of-time data. The command also disables the out-of-time detection mode.

114 SAVTIME

SAVE OUT-OF-TIME:

"SAVTIME" saves the out-of-time program into the EEROM. An "*" is printed for each 128 bytes of data saved. 16 blocks are saved in all. This function is performed automatically after the program and modify time routines.

115 GETTIME

GET OUT-OF-TIME:

"GETTIME" moves the out-of-time program saved in EEROM into the RAM memory. This function is performed automatically prior to the "MODTIME" routine.

116 PROGGATE XX

The PROGATE command allows the operator to program GATE data for the GATE he has specified. The SER will then prompt for all the necessary information. The unit first prompts for the type of Boolean expression which will be used. The prompt is for an AND or OR GATE, and the operator must then enter an "A" or "O" followed by an ENTER. Once the type of GATE is established, the SER prompts with the first GATE input number and also prompts for the channel number and state of this entry. The operator then enters the number and an "O" for an open contact or a "C" for a closed contact. If the information has been typed in correctly, the unit stores the data in its internal memory and prompts for the next entry. If the entry is not channel information, but rather another GATE, the format is "G xx" or "G xx N". In this format, the "G" signifies that this is GATE information rather than channel information, and the "xx" is the number of the specified GATE. "N" stands for the "not" condition which means the condition is disasserted. If the operator programs a GATE within a GATE, then there is a convention which must be followed. The SER searches for GATES in a prioritized manner. The unit begins processing GATE #64 and counts down as it searches through each successive GATE. If a GATE is going to be used within a GATE, then it must be one of a higher priority. That is to say, the number of the GATE used as an input must be numerically higher than the GATE being programmed. Prompting will continue until the operator terminates the programming session, or all 32 inputs are programmed. The programming is terminated by entering a "SKIP" (control C) when a prompt appears. When the program is complete, the SER transfers the data which has been entered into non-volatile EEROM for storage during a power down.

117 DSPLGATE XX

The DSPLGATE XX command allows the operator to get a printed record of the contents of a particular gate. The display will contain all of the entries of a particular GATE as well as the "AND/OR" information.

118 GATEDESC XX

The GATEDESC command is used to program the 32-character descriptor for the GATE specified. This descriptor is saved in EEROM for power down. It is printed during event printouts and when the GATE status is displayed. After the descriptor information has been entered and saved, the SER will prompt with the next sequential GATE number. To terminate the programming session, the operator enters a "SKIP".

119 GATESTAT

The GATESTAT command is the command which will initiate a display of the status of all 64 GATES. The nomenclature is identical to that used in the event printout. To alleviate the generation of unwanted information, no data will be printed for GATES which have no data programmed into them. The 32-character descriptors are also printed.

120 CLRGATE XX

The CLRGATE command clears all of the GATE data locations in the EEROM memory for the GATE specified. This makes the occurrence of that GATE impossible until it is reprogrammed.

NOTE: If no GATE number is specified, the SER will clear the data for all 64 GATES.

121 DISGATE

The DISGATE command provides a way to disable the GATE detection software without destroying the EEROM data. The flag which determines if GATE detection has been disabled or not is maintained in EEROM. This ensures that the GATE detection or lack of it is preserved during power down. This command effectively disables the Gate Analysis Option.

122 ENAGATE

The ENAGATE command is the complement of the DISGATE command. This command enables the GATE detection for any existing GATE data which is in EEROM memory. If the prior operation of the unit was such that GATE detection was enabled, then the SER will execute this command during its power on sequence. To verify that this command has been executed, the message "GATES OPERATIONAL" is printed during the execution of this command to signify that the Gate Analysis Software is operating.

123 ENAPROM

The ENAPROM command allows access to the portion of PROM U108 in which the Gate Analysis Software resides.

124 DISPROM

The DISPROM command disables any prior access to the portion of PROM U108 in which the Gate Analysis Software resides.

Dranetz Technologies, Inc.
1000 New Durham Rd. P.O. Box 4019
Edison, NJ 08818-4019
Tel: (908) 287-3680
Fax: (908) 248-9240

www.manualsplus.com
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